INVESTIGATION OF THE CHALLENGER ACCIDENT
(Volume 2)

HEARINGS

BEFORE THE

COMMITTEE ON SCIENCE AND TECHNOLOGY U.S. HOUSE OF REPRESENTATIVES

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CONTENTS

WITNESSES

APPENDIXES

INVESTIGATION OF THE CHALLENGER ACCIDENT

(Volume 2)

TUESDAY, JULY 15, 1986

House of Representatives,
Committee on Science and Technology,
Washington, DC.

The committee met, pursuant to recess, at 9:35 a.m., in room 2318, Rayburn House Office Building, Hon. Robert A. Roe (acting chairman of the committee), presiding.

Mr. Roe. The committee will come to order.

Today we continue our series of hearings relative to the Rogers Commission report on the *Challenger* accident. We have heard from numerous organizations and people from NASA and other parties that have a measure of involvement in the Shuttle Program. We are now at a stage where it is appropriate that we hear from three of the principal contractors responsible for developing space shuttle flight hardware.

We want to obtain their independent assessments of the Rogers Commission's conclusions regarding flight hardware, and we want to hear about whatever recertification efforts they are engaged in. Above all, we want to understand what is being done to correct design deficiencies and improve operating performances of flight hardware.

In the communication that was sent to our witnesses today there were a number—for the benefit of the committee—there were a number of items that were listed as key issues. And, for the record, each contractor's assessment of the work and the conclusions of the Rogers Commission as it related to their space flight hardware; what efforts each contractor has underway to recertify their flight hardware; how each contractor identified and responded to instances of anomalous performance by their flight hardware prior to 51–L; what is being done now by each contractor to correct design deficiencies or improve operating performance margins for their flight hardware; and finally, but not all-inclusive, each contractor's estimates of the time that will be required to complete the above tasks and have their flight hardware ready to reinstitute flight operations.

We will hear this morning from Mr. George Jeffs, president, North American Space Operations, Rockwell International; Mr. Richard Davis, president, Martin Marietta Michoud Aerospace; and George Murphy, executive vice president and general manager, United Technology Booster Production Co. And we want to welcome our witnesses this morning.

Before I call upon our first witness, I would defer to our distinguished ranking minority member, Mr. Manuel Lujan from New Mexico.

Mr. LUJAN. Thank you, Mr. Chairman. I don't have an opening statement; I just want to welcome our witnesses today. I suppose my observations or my questions today would have to do more with, where do we go from here? I think we've gone through what happened and we all quite well understand it, and I guess the important question now is, where do we go from here to get back into the space business?

Thank you very much, Mr. Chairman.

Mr. ROE. I thank the distinguished gentleman.

I would ask unanimous consent, and without objection, that television broadcasts, radio broadcasts, still photography, other means of coverage will be permitted during the full committee hearings this week on the Rogers Commission report. No objection; so ordered.

Now, if our three distinguished witnesses would rise and raise their right hand and repeat after me, I would appreciate their being sworn in at this point.

[Whereupon, the witnesses were duly sworn.]

Thank you, gentlemen.

Now the Chair recognizes Mr. George Jeffs, president, North American Space Operations. Mr. Jeffs, we have your testimony but I think none of the testimony is—you've done a good job in summarizing, so I think it would be profitable for the committee and for the record to do your full testimony as presented, if you don't mind.

Mr. Jeffs, we recognize you first.

STATEMENT OF GEORGE JEFFS, PRESIDENT, NORTH AMERICAN SPACE OPERATIONS, ROCKWELL INTERNATIONAL, EL SEGUNDO, CA

Mr. JEFFS. Well, Chairman Roe, members of the committee, I appreciate the opportunity to be here today with you.

I have submitted a statement for the record. I would like to add some supplemental comments to that, if I may.

I am a corporate officer of Rockwell International. I run the space and energy business segments for that company. We have about six divisions in space and energy; among them are the Space Transportation Systems Division and the Rocketdyne Division. The Space Transportation Systems Division is accountable for the orbiter design, fabrication, test, and support, along with the integration. Rocketdyne, on the other hand, is responsible for the design, fabrication, test, and support of the shuttle main engines.

I was a program manager on the support program for Gemini. I was the chief engineer of the Apollo CSM programs; I was a program manager of the Apollo programs for the Apollo-Soyuz programs, the lunar science programs, and the skylab programs, and I was the shuttle program manager from the beginning of Rockwell until about 1976 when I assumed my present job. I am also a long-term, many-year pilot so I have easy and complete empathy with flight safety.

Our review—which, as you might expect, has been done in great detail—of the Commission findings has led us to the conclusion that that effort by the committee was well done. They certainly consummated their charter. They identified the failure sources and the associated causal factors. We also, of course, during that process identified other areas that relate to all of our hardware, and we have looked at those with a fine-tooth comb.

I think one of the things that the Commission review has done for us in an overall sense that I think is very healthy is that it has brought about a new re-review of the total program, to have us go back and relook at our requirements and the certification testing that we've done, the design, basically, to meet those requirements in light of our flight experiences. I think that's a very healthy thing for the program at this time.

It turns out that most of the items that were identified by the Commission were in work before 51-L. Most of them were in the form of margin improvers, and I believe that most of them are incorporable before the next launch, which Dr. Fletcher the other day mentioned as being in the early part of 1988. That's with the exception of the escape system, which I'll talk about in just a little more detail in a moment.

The 17-inch valves have been a subject we've been working on for some time. Those valves, as you know, have to remain open in flight to feed the engines. If they inadvertently close it's a criticality-1 type of failure. On the other hand, they've got to close at the end of flight in order to make sure that we don't have external forces that would cause potential recontact of the bodies at separation.

We have some design ideas about how to put a positive lock on those valves which essentially fly in the LOX flow and the hydrogen flow during the engine operations. They're like little airfoils in there. We have a lock design that looks good. On the other hand, we want to be doubly careful of adding anything additional to that oxygen flow in the way of any kind of loose parts that might come—that might give us any sort of trouble in that flow stream. So that design has to be looked at from all angles, and we're doing that. Nonetheless, we believe that that system is qualifiable to the flow rates consistent with 109 percent engine operation, which essentially sets the flow rates prior to the next flight.

We've been working on the brakes for some time. The steering problems, so-called, are not really problems. The steering system is a single-string system; it was meant in the first place to be a backup system, but with the requirements of minimizing the load on the brakes, it's necessary that the steering system play a more active role. We are looking at redundancy in the steering system and the electronics in the steering system, in the electricals, and also in the hydraulics. You can only take this so far because it gets back single-string into the APU's, so we're looking at how we provide adequate redundancy in the steering system so that the crews themselves will have confidence in its workability to essentially unload the brakes. We, as you know, in this system don't have the advantages of thrust reversal and things like that that you have with the big airplanes, so we have to slow this system down otherwise, and mostly that load falls on the brakes. If we can handle the

steering, that prevents us from having to use differential brakes to keep the airplane on the runway. The steering system is, I think, easily doable to provide the redundancy that I believe will be acceptable across the board.

The brakes—we are adding capability to the brakes. The brakes are designed for about 42 million foot-pounds. You can get various energy absorption capabilities out of them, depending on how you use the brakes; but we are increasing that capability to about 65 million foot-pounds now, which should provide us with adequacy for cross-wind landings at recovery sites. We are doing that by increasing the stiffness of the axles and by essentially beefing up the thickness of the staters on the brakes. We have a plan that's a little bit more long-range that will put carbon brakes into it that will take our capabilities up to about 82 million foot-pounds which should be adequate for any occasion.

To do that, you're going to have to add some weight. And, of course, one of the reasons that brakes run into some degree of difficulty with this kind of a vehicle is that we've done everything possible to keep the brakes lightweight in the first place. Every pound that you put into brakes is a pound that you take out of payload. That just—digressing—of course, is one of the reasons that the nose gear is so short on this vehicle and why it has to fall through so far, and that's to shorten it up to save weight, unlike a large airplane.

On the engines, we are working the blades and bearing problems and have been for some time. The blades are really different than most people would think. For example, I'll hold up—that you probably can't see—this is a blade from an oxygen pump. That's a blade from a pump; it's pretty small. That little blade has about a 4,000-pound load on it that's tangential, a couple of hundred pounds that's normal to the blade surface in these high-speed pumps.

The fuel pump blade is a little larger, as you can see. We've had our first blade cracking problems, which we solved with coatings and otherwise, on the blades that were caused basically by thermal stresses when the engines started up. We've had subsequent cracking that's been brought about by thermal fatigue on these blades because they see not only the thermal stresses on startup, but they also see cycling loads during the operation of the pump.

The cracks that we have now are essentially down in the shank, clear down in here on these blades. As a matter of fact, on the fuel blade, they're down on the fir tree which is way down on the bottom portion of the blade itself.

We believe that we have a good solution to the oxygen blade with dampers. Those dampers essentially cut out the resilient condition on the blades that gives us reduction in the stresses that we're putting on the blades, and therefore increase their long-term, high-cycle-fatigue life.

With the fuel blades, we are working very hard on single crystal blades which increase the strength of the blades, and we think that should take care of the problem on the fuel side.

It's to be understood that these cracks are minuscule. It takes a magnifying glass to see them. I can't see them anymore with my eyes; maybe you can, but I certainly can't see them.

We have given ourselves confidence in flying the engine with those kinds of blades through off-limit testing. We've taken the worst cracked blades we could possibly find and run them in engines to see if we could make those cracks grow. We have not been able to do so. At the same time, it's not satisfactory for us to continue in the long-term flying cracked blades, and that's why we're putting so much effort on fixing those blades. I believe that we should have fixes for those blades before the next flight. I'm pretty sure that the dampers will take care of the problem with the oxygen blades; I think that our testing will prove and certify that we can do similarly with the fuel blades with single crystal material, although we'll also include those in the oxygen blades.

Right now, we are shooting for a goal in our spec of 55 missions with the engines, with maintenance. The principal maintenance item is the pump. We would like to increase that, of course, by getting these blade problems fixed and also by working on the bearings. The bearing problems are primarily brought about by cooling, and we are working on the cooling systems to reduce the temperature on those blades. We do turn the pumps around frequently, which is not comforting to us from the point of view of the maintenance time required; but at the same time, we take the pumps apart and take a good look at those pumps every time, which gives us further confidence that those pumps are adequate for subsequent flights.

So in the next flight we'll operate, the plan is, at 100 percent on those engines. I have confidence that the engines have great margin at 100 percent. At 104 percent I do think that we have margin, also. I think that the margin probably is on the order of 10 percent or a little more at 104 percent relative to just the fundamental strength of the engine. At 109 percent—we've run a lot of tests on the engine at 109 percent. I think the engine is satisfactory at 109 percent, albeit we don't have an awful lot of margin at 109 percent. We have run the engine to 111 percent. To be comfortable—as comfortable at 109 percent for normal, continuous, frequent operation as we are at 104 percent, we would recommend that we go to a larger throat, which we have designed and built, and that we also add to that the dual manifold gas system which would tend to unload and better balance the two pumps in the system and, I think, give us back the margin at 109 that we presently enjoy at 104.

Throughout the system we are looking at criticality-1 items, as you know, throughout. We are reviewing——

Mr. ROE. If the gentleman would yield for a moment.

Mr. JEFFS. Yes, sir.

Mr. ROE. Excuse me for interrupting you.

We may lose some continuity, which I don't think you want to do. I think you're going beyond some of the points, and I don't want to interfere with your testimony, but the way we are organized—you are including in your testimony all of the written testimony, which—all testimony will be accepted. But there are certain specific items that are very germane to this hearing today that I don't want to lose sight of, and you may want to also, in your excellent presentation, take the time—because I think it would be helpful to the committee; you must remember that you have extraordi-

nary background in this field and, in candor, there are some of us that are either awed or cowed by your presentation, and we don't want to do either. I think it would be awful helpful if you also would include—to follow the continuity on page 2, where you responded directly to the five or six different items we asked for.

The reason I suggest you do that, because I think it would be helpful for some of the questions that will emerge in reference to the criticality list that you spoke to earlier, some of the anomalies involved. And then we want to get in—you have covered on page 4 pretty well a number of the items, the technical items, which I think are very important as it relates to the brakes and so forth, which you're responding to. And then it seems to me, the item on page 4—it is item 5—which had to do with the timeframe. And I know that your testimony was prepared a day or two earlier, subsequent to Dr. Fletcher's response as to the timeframe for the 18 months versus the 2 years; in other words, when they felt they'd be ready to go back in flight. Do you follow where I'm coming from? In other words, I think it would be helpful—unless I'm interrupting your testimony—to talk a little bit about the criticality list specifically and what we're doing there on all items that would be considered No. 1 on your criticality list in your area.

Do I make any sense to you?

Mr. JEFFS. Yes, sir, to the first order. I was going to talk about criticality and FMEA's. The criticality-1 items, of course, on the orbiter are like in the numbers of 300 or 330 or 340, criticality-1-type items. On the engine, they're less than that; they're on the order of 90 or thereabouts.

Mr. LUJAN. I think what we're getting at—you start off, "First, regarding the work and conclusion of the Rogers Commission," and comment on that; and, "Second, under NASA direction, we have started"—in other words, follow it in the same order that you have it in your testimony so that we can follow it; I think that's basically what—start off with page 2. At the bottom of page 2, you start off, "First, regarding the work and conclusions of the Rogers Commission."

Mr. JEFFS. Well, I was really trying to address the things that are over and above the Commission report. You know, the Commission report, I think, touched very clearly on the 17-inch valves, on steering, on brakes. We have had continuous reviews of all the criticality-1 items on the program since the Commission report, and we have done a lot of work in parallel with that as continuing work on the programs.

The Commission report was not meant to identify or address all the issues on the program. I'll give you two, for example, that are of continuing concern to us, and one of those is the tile system. As you recall, of course, the Commission didn't say much about the tile system, nor was it expected to.

We continually review that tile system. It is a criticality-1 type of a system, if you will; we have had an occasional failure on that tile system. We had a problem with one of the tiles in the cold area when we lost a gap filler, and that high temperature gas is very unfriendly. So we are very careful to review the vehicle after every flight to identify where there might be any kind of a possibility of that plasma getting into the system itself.

I would think—of the criticality items that really trouble me on the program, that need continuous review of the development contractor, the tiles, the seals, and the gap fillers are all right among the top, as far as I'm concerned. We have had also problems with some slumping tile on the forward end of the vehicle, right underneath the chin. And we are working on some redesigns, and have been for some time, to take care of those particular kinds of problems.

There are some criticality-1 items in the system that, of course, will never go away; that's what's expected. That gives us the attention on the criticality items, but in fact there's nothing we can do to make them go away except to give them tender loving care to make sure that they're satisfied with the operation of our hardware. Such things of those are the elevons. The elevons, for example, are redundant except when you get down to the shaft on the elevons; it's a single elevon system, and we spent a lot of time on the program early to consider dual actuators versus single actuators, with all kinds of reviews, and finally concluded that single actuators were the thing to do for the system. Now, they are criticality-1, if you will, and will not go away; but our emphasis has been to make sure that everything is done to make those systems as perfect as possible.

The ET door is in the same category. That must close, and it must seal properly, so it is a criticality-1 type item and we make doubly sure that that works by over margins in the design and by actual clear setting up of the rating and so on and maintenance of the seals on those doors.

With the chairman's permission I would like to continue my thoughts here and then come back, perhaps, in specific questions to key items that you would like to emphasize.

Mr. ROE. Well, what the Chair plans on doing, for the benefit of all the witnesses—the answer, of course, to Mr. Jeffs is certainly; I don't want to break the continuity of your presentation, but I wanted to be informed that it's responsive to what we're asking for.

What I'm going to do is ask all three witnesses to make their initial presentation, initially coming off the five or six items that we referred to you by communication. We don't want—it's not the intention of the committee to limit you at all to the report, because the Commission itself found that its report that it made to the President and this committee and the people of the country only summarized certain parts, and they left initiative in other areas, which you're speaking to. And I don't want you to misunderstand me, that I want to limit that; I don't. What I'm trying to get at is four or five key items because there are a series of questions that have to do with timing and specifics that we're going to get into. That's where I'm coming from.

So I think you're fine where you're at; just go right ahead from there.

Mr. JEFFS. In summary on the timing issue, Mr. Chairman, I believe that all the changes that we believe are necessary to give us added margin in the system are doable within a time period that is of the first part of 1988. The reason that I say 1988 is that I believe, in order to get the single crystal blades into the engines, it's probably going to take us until about that time. Now, I believe we

could fly those engines safely before that; but I think for that added assurance of those blades, that's the time it would take.

The only item that we have that falls outside of that envelope is the escape system. We spent many, many weeks and months working escape system possibilities on this vehicle. We could not find a practical solution to it, certainly, for the SRB stage of the launch; and even after that, there was little that could be done to help the crew. So we concentrated our efforts on trying to make the basic system that much more reliable, if you will, as far as the orbiter and the engines are concerned.

We are presently re-reviewing all of that to see if those stumbling blocks are still with us. So far they appear to be, obviously, during the SRB phases. We are looking very carefully at a gliding flight situation in case of ditching. We have a number of concepts, if you will, on how that might be done; so far none of them look very practical to us. We are working very hard, though, to see what we can do to provide a practical system. We have a couple of ideas and we're pursuing those. Now, whether or not we can get that done and qualified for a 1988 launch is very questionable in my mind based on what I've seen so far. However, we have not given up.

I might point out that when I say that we turned our energies to try and make the system that much more reliable and safe, if you look at the system in depth you find, of course, that in the majority, it's fail-ops, fail-ops, fail-safe, which fundamentally means it's triply-redundant. So we have triple redundancies in every area that we could provide this in the vehicle; and, of course, we have large margins in areas that didn't subject themselves to such redundancies, such as structures and so on.

So I think with the triple redundancy and the tender loving care in putting this vehicle together and rating it and setting it up for flight, that we have done what we thought was necessary to provide a safe operation for the crew.

Now, it's clear that an area was missed on the SRB in that context, and one of the questions that arises is, where else in the system might you have similar kinds of problems waiting for you? As I say, we are very sensitive to any little signs that that vehicle shows us as a result of flying. You know, we've only flown the vehicle 25 times; it's a development article in an arena that we've never operated a vehicle in before, so anything that we see that's out of the usual, that's unusual, we take immediate steps to react to. And so does NASA. We get excellent support in those endeavors by the NASA; and the particular thing, as I say, that follows as an obvious example in that regard is the tile system and the seals and so on.

We have seen some problems with the vehicle at the Cape that shouldn't be. I guess you could potentially lay this at the feet of the reliability and quality assurance area, although reliability and quality assurance and safety is everybody's responsibility, not just a given organization. We have had some problems in the checkout of our vehicle that we have not been satisfied with, and I think that most people involved in this are well aware of it. They range from problems of misservicing of the vehicle, problems of oxygen probes loose in the system, and two areas where we have discov-

ered that the vehicle has been flown without complete, adequate verification of the adequacy of the testing on the tile systems on replaced tiles. I think those matters have been brought to the attention of the proper people at the Cape, and they are well aware of the sensitivity of those kinds of issues.

Mrs. MEYERS. Mr. Chairman, could I interrupt with a question right now?

Mr. ROE. Well, I know that I have 15 questions myself that I want to ask at this moment, but I think it would be more profitable—but I would be glad, if the lady feels that strongly about it, of course. But if we start that we're going to get into a whole series of questions. But go ahead. The lady from Kansas.

Mrs. MEYERS. Well, it's just a matter of clarification.

You said that there were problems with the checkout of the vehicle, and that sometimes it had been flown without adequate preparation. Now, when did you know this, Mr. Jeffs? In other words, what I'm trying to get at is, are these-----

Mr. ROE. If the gentlelady will yield?

Mrs. MEYERS. Yes.

Mr. ROE. I think the question is a valid one, but I think it's premature because I think we need the continuity.

What the chair is attempting to develop—and I think Mr. Jeffs is just getting into it—as you recall, in our whole series of hearings, what we're talking about here is, one, what happened from a technological point of view, which I think we've pretty well been through. The second point is management, and part of what he's speaking to now does have to do, in my judgment, with coordinated management.

So I think it would be profitable to get the input of Mr. Jeffs, Mr. Davis, and Mr. Murphy based upon the point of view—with NASA's attempt to coordinate and have a major umbrella over this situation—in effect, is that deleterious to those who are providing parts and pieces to the whole system? And I noted in some of the testimony, you're bringing that out—I believe Mr. Davis does—and if I'm not mistaken, I think you're touching on it.

So if you would hold back on your detailed question, I think it would be helpful. And let's get the input in first.

Go ahead, Mr. Jeffs.

Mr. JEFFS. Yes, sir. And I'll answer your question later, Mrs. Meyers.

Mr. ROE. And we'll call on you as quickly as possible.

Mr. JEFFS. And I'll expand later, if you wish me to, on the subject of the Cape.

Mr. ROE. Let me interject one more thought, if I may. Where we're coming from, because we want your effort to be meaningful here—it is appropriate that we call in the other hardware contractors, you people who are building this equipment, and we want a straight-forward approach. In other words, it's not all honey and cream—and you're mentioning that point—by far, because we're looking for a timeframe to improve.

So what I'm hoping we can bring out today, and it's an excellent opportunity for the witnesses in the greatest of candor to get across some of the points they want to make so that as the committee makes its determination for legislative remedial action, that those

areas of your concern are given attention to, fully recognizing the delicacy of discussion today.

Now, if Mr. Jeffs would continue from there.

Mr. JEFFS. Well, I'll wind up my comments on the cape.

The cape shuttle processing contract—as you know, we competed for that at Rockwell, as did some of my colleagues here at the table. I was never happy with the SPC approach to getting at the solution of the problem that was attempted to be solved.

The basic problem was—the intent was—to try and get the program more into an operational mode. We had no quarrel with that; however, we felt that the vehicle—it was too early in the development process, in the evolutionary process of the vehicle to separate the baby from the mother, so to speak. As a consequence we had trouble with that concept.

The basic concept that is fundamental here, in my mind, the concept that NASA's successes and all of our successes in the space program had been truly based on, is that of accountability. And accountability encourages extra tender, loving care; there's no question about it. We operate that way throughout our operations. There's no substitute for somebody knowing exactly who is responsible for what and when it has to be done, and they've got to stand up and say so.

The movement at the cape to take the hardware away from the developers, to cut down changes, to move it more into an operational arena does, in fact, diffuse accountability. And as a matter of fact, right now at the cape, what happens to our vehicle we're not fully aware of, as you know. We have a small cadre of people at the cape; there are some thousands of people that are involved in processing it. So we don't have full visibility of what does go on at the cape, and as a consequence the accountability moves to another arena with respect to the preparedness of the vehicle to fly.

I would like to say a few words about communications that relate to management problems—that at least have been alluded to as management problems in some of the previous discussions and testimonies. First off, I'd like to say, within Rockwell, the communication is very clear. We have frequent discussions and reviews of all elements of the hardware down into depth in all the things that we do on the program at my level, and the people that I work for—the president of the company has monthly reviews in which we also bring consultants into it, such as Dr. Christopher Kraft and others, who have no problem in speaking their minds and identifying issues as we proceed.

The president of our company is very familiar with the details of everything that we do. He is very familiar with our commitments to fly and any problems associated with those commitments, just as I was in the last flight. So is the chairman and the chief executive officer, who is deeply involved and very interested not only in the space program, but more particularly, the shuttle.

We do have a unique relationship with the NASA. It's built up through the years of working with the NASA. We have great technical regard for each other; as a consequence, we listen to what each other has to say. We don't always agree, but in fact, we do have ways to come to decisions on problems. That's been classical; there's nothing new about that.

We have people in the mission support rooms at Houston. We're in real time on all problems that are arising before, during, and after the flights. We have mission support rooms at Downey where, in fact, we receive real time data, and we have specialists involved in each one of these areas of concern before, during, and after flight.

If we're not satisfied, we tell it like it is, and we don't have any hesitation in going to the program managers, to the division directors, and to the NASA Administrator if needs be, to express our views.

On the ice problem at the cape, it was unfortunate. It was unfortunate that ice existed in the first place. There was a plan to prevent that from occurring, draining the system—trickle-draining the system—so that it didn't freeze. That didn't work very well, so we did end up with ice. Now, we're not on the ice detail—the ice teams are responsible for ice on the pad. We do have people there that informed us of the ice; and, of course, we saw the ice on television. We had people working the problem during the early morning hours to try to see if we could analyze the potential trajectories of the ice particles during the launch phase, including the aspiration effects as the vehicle passed by the stand. We couldn't do it; we couldn't analyze it very well. We didn't know where the heck the ice was going to go. The NASA were very capable, were trying to do their own analyses. That gets down to details of exactly the air flow, the wind flow, the ice location on the vehicle, et cetera; it turned out we still didn't know where the ice was going to go.

We are concerned about the ice with those tiles that I mentioned earlier. We've had ice experience before. Ice is not new to us; we've had lots of ice damage to the tiles from the external tank during the launch phase. A lot of work has been done to remove those sources. That damage has been getting less. It was clear from the background that we did have that even though we'd suffered damage to the tiles, breaking of the borosilicate surface, some damage to the tiles, that we'd never had a situation that was really vehicle-threatening from that during reentry. There was some further expansion of that, of those damaged areas, but none of them were really vehicle-threatening. Nonetheless, we don't like it; we're conservative about it. We told the NASA about it.

Now, my people called me, said they wanted to make a strong recommendation to the NASA that we not fly because of the concern for where the ice was going to go. That got to the program manager, Arnie Aldrich. He's a very good one. He knows the tile problem; he's got lots of people that know the tile problem. I knew he knew about the tile problem. We did not have a firm data base to say that, in fact, that ice damage was in fact going to give us a mission-critical type of a problem.

We'd expressed our concern to Arnie. Arnie, in a position of having all the information—more than we did, including the results of the ice review teams and so on, on the pad—made the decision. That's what program managers are for; not all decisions are go-no go decisions in this world. If they were, we wouldn't need any program managers and that would be an awfully lot easier job than it is right now.

I felt confident that he understood the situation in depth, that he was well informed of our position; that he overruled our concern—not necessarily our go-no go positive position on flying. I had enough confidence in that, so I didn't pick up the phone and call him. If I'd felt that that was threatening to the vehicle, I wouldn't have hesitated to do so, or to have gone beyond Arnie if that was necessary. That's essentially the ice story from my view.

I would like to say, if I may now, a couple of words about pride, accomplishment, and technology. The orbiter and the SSME's have performed as required on all missions. We have enjoyed, and have through the years, on Apollo and shuttle, hearing from the astronauts, the flight controllers, the engineers, that "Rockwell, you build great hardware." And when you can sit there and watch those CRT's hardly deviate on all the systems hour after hour, day after day, you know that hardware really is great.

When we started to build this vehicle, we determined that we were not going to get into development areas that were unnecessary. For example, there was no need for us to develop a new computer. There was no need for us to develop a new platform. What we wanted to do was to use that hardware off the shelf and free ourselves to focus on the more demanding technological problems of the thermal protection system; of the reusable, lightweight, high-performance rocket engines; of the hypersonic, aerodynamic, and control system for the vehicle; and, of course, the software to interact this hardware-software interface of this system.

The system has sometimes been alluded to as "not state-of-the-art," which is obviously poor thinking. The system is, as a matter of fact, the epitome of the state-of-the-art. We don't know how to do it any better when it comes to those major technological areas. It is true, we're upgrading the system with new computers, new platforms, new fuel cells, but those are minor. Those aren't fundamental to the basic thing that the shuttle does.

The shuttle, therefore, certainly need not be criticized because it's not the newest of technology. That comes from a misguided objective, in my view. The shuttle does what it's supposed to do; there's no need to replace it and there's no need to spend a lot more money on it, except to provide additional shuttles for the future.

And with respect to the future, the shuttle is the cornerstone of the United States potential future space program for the next two or three decades. Our future in space depends on it. It's more than a booster; we have done it a great injustice to compare it only as a booster. Its excellence and its productivity lie in what it can do on orbit. The Russian system, as you know, has a boost system; has a logistics resupply vehicle. It must rendezvous and dock, and it must return payload and crew to earth with some degree of dignity which the Russian system, of course, doesn't do. The shuttle is all those things. It's not just an ELV; that's just a sidelight for it. So ELV's don't compete with the orbiter, except in the boost phase. For ELV's to compete with the orbiter is to compare Barishnikov to an elephant, in my view. The orbiter is essentially all the things we can really do in space rolled up into one.

We're just beginning to use this manned machine. I've been awed by the things that we can do in this man-machine combina-

tion. It's fundamental to me that the future of space depends upon manned machines, along with the unmanned machines; but man's going to be the key to our progress as we continue on. And shuttle makes the space station, in that regard, and the SDI beginnings possible; without it, they are not possible.

I believe also that through it, primarily, we have the world lead in space right now. We must use it and do the things with it that make it possible for our society to continue on to the stars, but space operations will never be risk free. There is an awful lot of energy involved, going up and coming down, and there are a lot of things to be done on orbit that involve risk, not the least of which is EVA.

We must minimize that risk but we've got to accept it as being with us always in our space decisions.

It's amazing how quickly we forget. I can remember the day, the first flight with Crippen and Young, coming back on the first mission. What a tremendous relief it was to me when they came out of blackout; because with all the testing that we had done, everything that was within our reach with respect to tunnels, plasma jets, arc jets, everything else, we still couldn't duplicate the detailed characteristics that this vehicle was expected to generate on hypersonic reentry. It was a tremendous relief and a tremendous engineering gratification for the whole organization on how beautifully the machine did perform in a region in which we had never ever operated before, and that's a lot of risk. No question about it.

But we've done it, and America is going to have to continue to do that if we're going to be a bold space leader. We're going to have to make those kinds of bold decisions. We've got to step up to it like we have and not be a timid also-ran. And I think the shuttle's the key to that.

Thank you for bearing with me, Mr. Chairman. That concludes my remarks and subsequently I'll try to handle more specifically the questions that you and your committee have.

[The prepared statement of Mr. Jeffs follows:]

STATEMENT OF

GEORGE W. JEFFS

PRESIDENT

NORTH AMERICAN SPACE OPERATIONS

ROCKWELL INTERNATIONAL

BEFORE THE

COMMITTEE ON SCIENCE & TECHNOLOGY

U. S. HOUSE OF REPRESENTATIVES

JULY 15, 1986

Mr. Chairman and members of the Committee. My name is George W. Jeffs. I am a vice president of Rockwell International Corporation and president of Rockwell's North American Space Operations, headquartered in El Segundo, California. I have prime responsibility for programs and products which cover a wide range of high technologies and which are space and energy related.

Rockwell has been extensively involved in the nation's space program for over 25 years. We were the prime contractor for the Apollo command and service modules, for the Saturn second stage, and for all the Saturn engines. Our participation in the Space Shuttle program has been equally extensive. Our Space Transportation Systems Division, headquartered in Downey, California, builds the Space Shuttle orbiters and assists NASA with orbiter operations, mission operations, and cargo and system integration. Rockwell's Rocketdyne Division, headquartered in Canoga Park, California, builds the Space Shuttle's main engines.

I will now comment briefly on the five topics identified by the committee for discussion.

First, regarding the work and conclusions of the Rogers Commission as it relates to Rockwell flight hardware, we are aggressively pursuing the recommendations of the Commission. Many of these actions were in progress prior to the Challenger accident, and some actions, resulting from our internal reviews, are over and above specific Commission recommendations.

Second, under NASA direction, we have started the recertification process for the orbiter and Shuttle main engine hardware and software. We are reviewing all design requirements in light of operational experience, to assure that the previous certification tests are still appropriate. We are also reviewing our failure mode effects analyses (FMEA) and, where necessary, updating our Critical Items List (CIL) to reflect the latest operating conditions. In the case of the main engine we are extending the analysis to include a lower level of detail parts and the structural failure mode effects of pressure vessels. Associated hazard analyses will also be upgraded. The Operations and Maintenance Requirements Specification Document is being reviewed in conjunction with the FMEA and CIL, and will be updated to reverify that Criticality 1 hardware is thoroughly preflight tested. A program-wide design certification review is also planned by NASA which will formalize the review process of the entire system, including all hardware and software modifications prior to the next flight.

Third, regarding identification and response to anomalous performance, a comprehensive, detailed inspection of orbiter and engine hardware and review of operating data are performed before, during and following each Shuttle flight to identify anomalies. Any such anomalies or others occurring during separate ground testing activities are formally tracked by both Rockwell and the NASA and are resolved by engineering prior to subsequent flights.

Fourth, several hardware components on both the orbiter and main engines are presently undergoing modifications to enhance design margins and increase operating life. The principal orbiter hardware which is being modified at this time to support the next flight is:

a. 17-inch external tank/orbiter disconnect--adding a positive locking feature
b. Brakes--adding upgrade features to increase stopping capability from 42 million foot-pounds to 65 million foot-pounds
c. APU fuel isolation valves--adding second valve temperature sensor for power removal indication
d. Reaction control system--adding an automatic de-select feature if jet instability is detected
e. Avionics system (analog to digital transformation chip)--performing computer byte tests of the multiplexer output to validate data

The following main engine margin improvements are being made:

a. Turbopump bearings and blades--material and process changes and turbine blade dampers to increase life
b. Main combustion chamber outlet--nickel plate to increase life
c. Main engine controller--hardware and software upgrades

Fifth, the specific modifications identified to date and discussed above will be completed in 18 months. The technical feasibility of crew escape systems is being explored. The potential schedule impact of such systems has not been determined at this time.

The Space Shuttle orbiter and its main engines have demonstrated outstanding performance due not only to a sound design and test verification foundation, but, also, to continued attention to detail in the pre and post flight inspections, data review, and anomaly resolution process. Current outgoing actions in preparation for the resumption of flight activities will further enhance operating margins.

Thank you for the opportunity to speak to you today and I will be happy to answer any questions you may have for me.

Mr. ROE. Thank you very much, Mr. Jeffs.

Our next witness is Mr. Richard Davis, president, Martin Marietta Michoud Aerospace.

STATEMENT OF RICHARD M. DAVIS, PRESIDENT, MARTIN MARIETTA MICHOUD AEROSPACE, NEW ORLEANS, LA

Mr. DAVIS. Mr. Chairman and distinguished members of the committee, I am Richard M. Davis, president, Martin Marietta Michoud Aerospace in New Orleans, LA, where we manufacture the external tank for the space transportation system. I have with me today my director of engineering, Mr. Jon Dutton, and my director of product assurance, Mr. Arthur Welch.

Our responsibilities at Michoud Aerospace cover the design, development, test, manufacture, and delivery of the external tank, the support to the launch processing of our hardware at the launch sites, flight readiness reviews and commitment, the analysis of flight data, and corrective actions relating to any anomalies identified. We have operated in this mode with only one change since the external tank program started in late 1973. In 1983, our "hands on" external tank processing and facilities activation responsibilities, which we had performed since the program began, were reduced to a review and support activity to the shuttle processing contractor.

I have been with the external tank program for 7 years, while Jon and Art have been with the program since its start 13 years ago. We are extremely proud of the external tank record of mission success, quality, safety, on or ahead of time delivery, and cost reduction through productivity improvements.

I will present summary answers to your five questions in my opening remarks, commenting only briefly on the charts provided. You may wish to call back some of those charts when I finish, and all three of us are prepared to respond to your questions in our respective areas of expertise and program knowledge.

Your first question was, "Your assessment of the work and conclusions of the Rogers Commission as it relates to your flight hardware."

Since we have received only volume I of the Commission report, I will limit my comments to that volume.

In providing very close support to the NASA investigation teams formed as a result of the 51-L accident, we attended numerous meetings between the NASA and Commission panel members. In addition, we met directly with members of the Commission on two occasions. The first time was on March 13 at Washington in an informal session to present our conclusions that there was no possibility that a liquid hydrogen leak from the external tank contributed to the accident. The second time was on April 8 and 9 at Michoud in formal testimony relative to the development and production of the external tank.

On the basis of our internal investigations and support to the NASA investigations, we agree totally with the Commission finding that the external tank did not cause, or contribute to the cause, of the 51-L accident. We also have no disagreement with the Commis-

sion conclusions relative to our flight hardware, which I will discuss in the later questions.

The Commission also addressed the issue of launch processing and involvement of the development contractors in that processing. They concluded that the establishment of a single shuttle processing contractor, prompted in part by both the assumption of the space shuttle being operational and the objective of reducing operational costs, is inconsistent with the developmental nature of much of the flight and ground support hardware. They also felt that the development contractor's commitment to launch should be complete and unequivocal.

The current role we perform at Kennedy Space Center, support services only, does not provide us with total visibility of all events affecting our hardware and forces us to rely heavily on review of documentation after the fact for our determination of launch readiness. Working in this mode of oversight and review does not allow us to take total advantage of our technical skills and knowledge of the flight hardware to ensure mission success. We agree with the Commission that the development contractor's responsibility should be "beginning to end" to give the maximum assurance of flight safety. We believe that it is essential that we again resume the responsibility for those functions which directly involve processing the ET flight hardware, including engineering, quality, planning, and inputs to the KSC flight readiness reviews.

I'll depart a little bit here from the text to indicate that I have specifically pointed out those latter things—the engineering and so forth—because the SPC at this time works in a mode of a pool of engineering that services all contractors, and we believe that is not the right way to do the job.

This could be done either under contract to the SPC, as the Commission implied, or directly to the NASA/KSC. Only with such a change can a complete and unequivocal launch commitment from the shuttle development contractors be achieved.

The Commission also recommended, and the NASA has announced, the formation of a combined Safety, Reliability, and Quality Assurance Office reporting directly to the Administrator of NASA. We support these actions and believe that the office should function in a strong oversight role and in a manner that the responsibility for insuring flight safety remains squarely on the shoulders of the NASA project officers and their contractors. As such, at the flight readiness reviews, this office should not be asked to commit that the system is ready to fly, but rather to declare whether all significant items have been presented, whether they agree with the resolutions reached, and whether they have any reasons that the launch should not proceed. This may seem like a fine point, but I believe it is very important.

At Michoud Aerospace, these functions—safety, reliability, and quality assurance—are combined under Mr. Arthur Welch, the director of product assurance, reporting directly to me, and we operate in the above fashion. In addition, I have a director of mission success reporting to me who structures our flight readiness reviews and provides an independent assessment of the completeness and adequacy of our prelaunch activities.

I might divert a little bit to indicate that mission success is a way of life at Michoud. It drives all our decisions. Clearly, mission success is much more important to us than cost or schedule.

Your second question was, "What efforts you have underway to recertify your flight hardware."

Our approach to recertification of the flight hardware requires that we critically re-review all aspects of the external tank development, manufacturing, and flight program. Chart 1 shows the six major elements of this approach and how it reflects and supports the NASA recertification plans, including those identified in Admiral Truly's "Return to Flight Status" memo.

For the FMEA/CIL-Hazard Analysis element, in addition to the re-review by Michoud Aerospace, Marshall Space Flight Center has contracted with Rockwell for a totally independent analysis, providing another degree of assurance. Coordination with the Marshall Space Flight Center External Tank Project Office on all these elements of recertification is accomplished by weekly telecons and formal periodic reviews.

Your third question was, "How your firm identified and responded to anomalous performance of flight hardware prior to 51–L."

Chart 2 shows the sources of data analyzed on each flight to identify anomalies, who at Michoud Aerospace and NASA performed these analyses, and the formal method of documenting and dispositioning these anomalies properly prior to the next flight.

Charts 3 and 4 identify the external tank hardware on which flight anomalies occurred, the criticality classification of the hardware, the type of failures that occurred, and the corrective actions taken. Our most troublesome items have been the pressure transducers, a criticality-1R item, and the thermal protection system. TPS was not previously assigned a criticality classification. Data on the transducers is received on each flight, while separation photos of the TPS have been obtained on only 6 of the 18 lightweight tank flights. As such, we must infer from the orbiter tile damage whether TPS has been lost. Since tile damage can come from many sources of debris—the launch pad, the solid rocket boosters, the orbiter itself, and the landing strip—this is not an easy task. Corrective actions have been taken as shown for both the transducers and the TPS.

We also look at the hardware anomalies during build and test at our suppliers and at the Michoud assembly facility to establish trend data and possible correlation with flight anomalies. This data is analyzed to determine preventive actions as well as corrective actions; for example, the similarity of ullage transducer failures in flight and during acceptance test at the supplier indicated a manufacturing problem. As a result, we improved the manufacturing methods as well as the inspection and test requirements.

Your fourth question was, "What is being done now to correct design deficiencies or improve operating performance margins in any of your flight hardware?"

The external tank has been designed and qualified to withstand 125 to 140 percent of the maximum expected applied design loads and environments. These include overall vehicle loads, aerodynamic, pressure, vibration and acoustic loads, and applied thermal heat loads. A review of the previous flights indicates that the maximum

actual load was 92 percent of the design load, and the applied heating rates have been no greater than 76 percent of the design requirements. Additionally, the propellant loading accuracy for the external tank is 0.2 and 0.25 percent as compared to 0.41 and 0.3 percent specification requirement for the liquid oxygen and liquid hydrogen tanks, respectively. The propellant interface parameters, pressure and temperature, between the external tank and the orbiter are being maintained well within the specification requirements. All of the propulsion and electrical components have been qualified to the predicted environments. To date, the ongoing reviews have not indicated any areas where operating performance needs to be improved.

The external tank hardware currently undergoing evaluation for design improvement is shown on charts 5 and 6. These charts identify the criticality classification, the type of failure modes of concern, whether we have experienced that failure mode in qualification or in flight, and the redesign approaches under study.

There are "use as is" options which could be viable choices if it is decided that the alternatives present increased risk. For example, the current mechanical transducer failure mode is a "soft failure mode" which results in a temporary loss in data or a small error in the data, which is preferable to a hard failure which results in total loss of data. One of the options, the electronic transducer, does have potential hard failure modes.

The range safety system is not listed because of any known defect in the design or hardware. We believe it has been well designed and that we have adequately protected the linear shaped charges. Level II is reevaluating the requirements for the system to remain on the external tank. Removal of the system would eliminate one more in-flight hazard. We hope this can be done.

We have listed the 17-inch disconnects, provided to us and currently under study by Rockwell, since it is pertinent to answering your next question on schedule. Details on the failure modes or improvements should be obtained from Rockwell.

Your fifth question was, "Your estimates of the time that will be required to complete the above tasks and have your flight hardware ready to reinstitute flight operations."

Yesterday, Dr. Fletcher announced early 1988 as their new flight date. My next statements, which refer to July 1987, obviously are then true for the 1988 date.

Completion of the recertification tasks, including the formal design certification review in 1987, has been structured to support the current July 1987 next launch date. While not all the design improvement options—those are hardware options—could meet that date, we believe we have viable hardware options available which would support a safe flight in July 1987. However, we need to point out that the rereview activities are still in progress, and that this evaluation is based only upon the hardware design improvements identified previously.

In the case of the 17-inch disconnects, we must defer to Rockwell for schedule. However, we can state that if the interfaces with the external tank remain the same, we can remove and replace the 17-inch disconnects in about 30 days, and that it should be done before mating with the orbiter.

While July 1987 is the current planning date for the next launch, I am confident that, as Admiral Truly has stated, we will fly only when it is safe to do so.

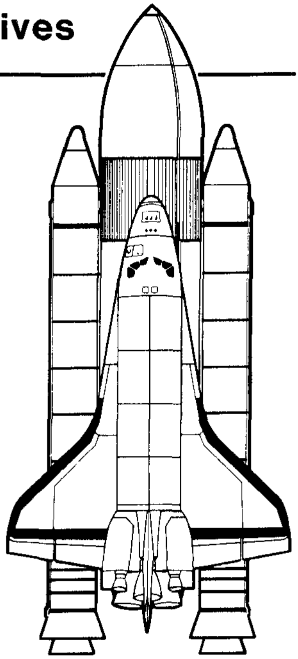
We would now welcome any questions about the material presented or any other subject of interest to the committee.

[The prepared statement of Mr. Davis follows:]

MARTIN MARIETTA

Hold for release until
presented by witness
July 15, 1986

Committee on Science and Technology
U.S. House of Representatives



Statement by:

Richard M. Davis
President
Martin Marietta
Michoud Aerospace

OPENING STATEMENT

Mr. Chairman and Distinguished Members of the Committee.

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We also look at the hardware anomalies during build and test at our suppliers and at MAF to establish trend data and possible correlation with flight anomalies. This data is analyzed to determine preventive actions as well as corrective actions. For example, the similarity of ullage transducer failures in flight and during acceptance test at the supplier indicated a manufacturing problem. As a result, we improved the manufacturing methods as well as the inspection and test requirements.

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We have listed the 17" Disconnects, provided to us and currently under study by Rockwell, since it is pertinent to answering your next question on schedule. Details on the failure modes or improvements should be obtained from Rockwell.

Your fifth question was: **"Your estimates of the time that will be required to complete the above tasks and have your flight hardware ready to reinstitute flight operations?"**

Completion of the recertification tasks, including the formal Design Certification Review in 1987, has been structured to support the current July 1987 next launch date. While not all the design improvement options could meet that date ,we believe we have viable hardware options available which would support a safe flight in July 1987. However, we need to point out that the re-review activities are still in progress, and that this evaluation is based only upon the hardware design improvements identified previously.

In the case of the 17" Disconnects we must defer to Rockwell for schedule information. However, we can state that if the interfaces with the External Tank remain the same, we can remove and replace the 17" Disconnects in about 30 days and that it should be done before mating the External Tank with the Orbiter.

While July, 1987 is the current planning date for the next launch, I am confident, that as Admiral Truly has stated, we will fly only when it is safe to do so. We would now welcome any questions about the material presented or any other subject of interest to the Committee.

Re-Certification Program — Chart 1

Activity	Description	Involvement
System Requirements (Adm. Truly Item)	- Review Level II Document (JSC 07700 Vol X)	- MMMA-MSFC-JSC
	- Ensure ET-EIS Compatiblity	- MMMA-MSFC
	- Review loads, thermal, acoustics environments documents	- MMMA-MSFC
	- Update margins	- MMMA-MSFC Review
Manufacturing Requirements and Processes	- Engineering drawing and process specifications	- MMMA
	- Review process instructions	- MMMA
	- Review mfg. process plan	- MMMA
	- Verify hardware configuration	- MMMA
FMEA/CIL - Hazard (Adm. Truly Item)	- Complete Reassessment	- MMMA-MSFC
	- Independent outside audit	- MSFC-RI
	- Revised CIL and Hazard Catalog	- MMMA-MSFC-JSC
OMRSD/OMI and Launch Commit Criteria (Adm. Truly Item)	- Total review for clarity, intent, rationale	- MMMA-MSFC-KSC
	- Relation to CIL and Hazards	- MMMA-MSFC-KSC
Delta Design Certification Review (Adm. Truly Item)	- Total re-review of ET certification	- MMMA-MSFC-JSC
	- MMC resources committed	- MMMA
Flight Readiness Review and Operations (Adm. Truly Item)	- Format and content of FRR	- MMMA-MSFC
	- Subscribe to "Commit to Launch" process	- MMMA-MSFC

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ET Flight Evaluation Activity

Chart 2

Data Source

- Countdown Data
  - Propulsion Console
  - Electrical Console
  - Temperature Console
- Flight Data Telemetry
  - Propulsion Console
  - Electrical Console
  - Temperature Console
- Launch Cameras
- Separation Photos
- Orbiter Data (Fly-Back)
- Orbiter Tile Damage Assessment Team

Data Analysis

NASA
- KSC
  - System Managers
  - Launch Director
  - ET Program Manager
- MSFC-HOSC
  - Chief Engineer
  - MPS Chief Engineer
  - Console Managers

MMMA
- KSC
  - ET Program VP
  - LSS Director
  - Chief Engineer
  - Console Managers
- MSFC-HOSC
  - Site and Test Managers
  - Engineering Managers
  - Console Monitors
- MAF-MSR
  - Technical Team

Anomaly Documentation/Disposition

- Flash and Quick Look Reports
- Flight Action Request
  - MMMA/ET Engineering Director
- Flight Test Problem Report
- ET Performance Report Performance Summary
- Problem Control Sheet
  - MSFC
- Corrective Action Problem Summary
  - MMMA/MSFC
- Flight Readiness Review
  - MMMA/MSFC

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External Tank Flight Anomalies — Chart 3

Flight Hardware	Criticality	Failure Mode	Disposition/Corrective Actions
• LO Level Sensors (1/1)	III	Continuous Wet Indication	Use-as-designed; not a flight safety issue; no subsequent flight hardware failures
• Temperature Sensors (5/2)	III	Inoperative	Use-as-designed; not a flight safety issue; nose cone and intertank temperatures can be controlled by heated ground nitrogen purge flow
• LH Ullage Pressure Transducers (3/2)	IR	Isolated Signal Dropouts	Retrofitted fleet with new transducers; (enhanced inspection requirements and 200 cycle burn-in)
• LH Ullage Pressure Transducers(1/1)	IR	Biased Readings	Retrofitted fleet with new transducers; (enhanced inspection requirements and 200 cycle burn-in)
• LO Ullage Pressure Transducers	IR	Isolated Signal Dropouts	Retrofitted fleet with new transducers; (enhanced inspection requirements and 200 cycle burn-in)

(x/y) x = no. of anomalies
y = no. of flights

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External Tank Flight Anomalies — Chart 4

Flight Hardware	Criticality	Failure Mode	Disposition/Corrective Actions
• TPS (*/4)	Under review	Divoting (Intertank)	Engineering change provided vent holes
• TPS (**/8)	Under review	Minor loss of TPS	Continue to improve processes and limit repair to further reduce maintenance on the orbiter tiles

*Damage verified by flight separation photos on 4 flights and inspection of orbiter after those flights

**Lack of significant damage verified by inspection of orbiter after flight and by separation photos on two of the eight flights

(x/y) x = no. of anomalies
y = no. of flights

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Design Improvements — Chart 5

Issue	Discussion	Options
• Item: LH Pressure Transducer (Crit. 1R) Concern: Previous minor performance anomalies	- No impact to flight performance - Small bias in output or short signal drop out - Caused by winding wear or wiper lift off	- Use as-is - Improve current design - Redesign to all electronic - Voting logic (RI) - In flight switch (RI)
• Item: LH Vent Valve (Crit. 1) Concern: Indicated closed valve could be leaking	- H2 dump overboard at lift off - Ignition source and burning - No qualification or flight history of valve leakage problem	- Use as-is - Use as-is (with independent measurement) - Modify current design (proximity switch) - New valve design
• Item: Thermal Protection System (TPS) Concern: Loss of TPS	- Post separation photos show TPS Divot Loss - Debonds caused by vendor constituent material substitution - Contributes to orbiter tile damage	- Redesign to eliminate problem - Fingerprint of materials composition

MARTIN MARIETTA

Design Improvements — Chart 6

Issue	Discussion	Options
• Item: ET Range Safety System (Crit. 1)	- Electrical sneak circuit - Thermal environment and autodetonation sensitive	- Use as-is - Use as-is with mod. - Place LSC inside intertank
Concern: Inadvertent detonation	- Level II (JSC) - AF is studying	- Remove totally from ET only
• Item: 17" Disconnect (Crit. 1)	- GFP installed on ET at MAF	- Rockwell should discuss
Concern: Premature closure	- No failures in flight	

MARTIN MARIETTA

Mr. ROE. I thank the gentleman.
Mr. Murphy

STATEMENT OF GEORGE J. MURPHY, EXECUTIVE VICE PRESIDENT AND GENERAL MANAGER, USBI BOOSTER PRODUCTION CO., TITUSVILLE, FL, SUBSIDIARY OF UNITED TECHNOLOGIES CORP.

Mr. MURPHY. Mr. Chairman, distinguished members of the committee, I am George J. Murphy, executive vice president and general manager of the Booster Production Co., a wholly owned subsidiary of United Technologies Corp., and have been associated with the company for 8 years, and the program as well. Also attending with me today are Mr. Gene Cagle, the Booster Production Co. program manager, who has held this position for 5 years; and Mr. Don Reed, the BPC SRB chief engineer, who has been associated with the program for 9 years.

I am here today to provide the committee an understanding of our contractual commitments in support of NASA's Space Transportation System solid rocket boosters, and to, first, assess the conclusions of the Rogers Commission as it relates to the SRB flight hardware for which the Booster Production Co. is responsible; second, discuss the efforts that the Booster Production Co. has undertaken to recertify the flight hardware; third, to outline the methods and analyses used to identify and respond to the anomalous performance of flight hardware prior to 51-L; fourth, explain what is being done and what will be done to correct design deficiencies and/or improve the operating performance margins in the SRB flight hardware; and, fifth, estimate the time required to complete the recertification task prior to flight operations being reinstituted.

First, I would like to give you some of the background defining our role in the shuttle program. The USBI Booster Production Co. and its predecessor company, United Space Boosters, have been under contract since December 1976 with the George C. Marshall Space Flight Center to assemble and refurbish solid rocket boosters for reuse. This excludes the solid rocket motor. The original contract required USBI to assemble, recover, disassemble, and refurbish six SRB flight sets of hardware designed and furnished by NASA/Marshall. The SRB hardware development and design verification had been performed by NASA/Marshall. Beginning with the seventh flight, STS-7, USBI also assumed responsibility for the procurement of the flight hardware—excluding, again, the solid rocket motor.

The production contract required USBI to furnish a total of 20 SRB flight sets to NASA/Marshall, and our current contract provides for an additional 64 flight sets, for an overall total of 84 flight sets. In January 1984, the SRB recovery and disassembly functions became the responsibility of the Kennedy Space Center Shuttle Processing Contractor.

The SRB has six major subsystems, as shown on the SRB pictorial, which are the responsibility of the Booster Production Co. for procurement, refurbishment, and assembly. These subsystems are structures—these are on the right-hand side of the pictorial, and

they include the nose cap, the frustum, the forward skirt, the aft skirt, the system tunnel; the decelerator system, at the top left of the pictorial—it is the pilot and drogue chutes, the altitude switch and the main parachutes; the electronic and instrumentation system is below that, and this includes the forward IEA, which is the integrated electronic assembly; the rate gyros; the sensor timer unit, batteries, and cables.

The thrust vector control system, which is at the bottom of the left-hand side—this includes basically the guidance system for the SRB. The range safety system, which includes the panel and antennas and the linear shaped charge, and then the separation system itself, which contains the forward booster separation motors in the frustum, and then the aft booster separation motors, is located in the aft skirt.

In addition to the assembly, refurbishment, and delivery of the described flight hardware, Booster Production Co. also provides design and sustaining engineering. Liaison and launch site support are provided to NASA, the shuttle processing contractor, and to Vandenberg Air Force Base to assure that a common understanding exists as pertains to the system design, operational requirements, and limitations of the hardware furnished, and to ensure compatibility of checkout procedures and anomaly resolution.

The following is in answer to your first question regarding the Rogers Commission work and conclusions.

Because of our mission responsibility to support the launch operations at KSC and the Huntsville Operation Support Center—HOSC—in Huntsville, our key managers and engineers were on station when the 51-L accident occurred. We immediately implemented the SRB anomaly investigation plan at USBI Booster Production Co. and were on site in the HOSC to assist NASA/Marshall in the establishment and staffing of an SRB contingency team. Our personnel cochaired six subteams and provided technical expertise to formulate and plan the SRB subsystem investigations. We immediately impounded all of the 51-L related records and data, and during the ensuing weeks of investigations, our personnel not only scrutinized the myriad of detailed records of 51-L, but technically challenged the design, failure modes and effects analyses, and potential SRB failure trees that could have contributed to the 51-L accident. The United Technologies Corporate Office organized a multidisciplined team of engineers to conduct an independent audit of the Booster Production actions related to the 51-L assembly and test operations, as well as review all engineering decisions relating to the 51-L hardware disposition. We were pleased with our findings and those of the Marshall teams on which we served, in that the SRB hardware provided by USBI-BPC for 51-L was built and processed in accordance with the design requirements. The review showed that our systems of control were in place and functioned properly. In regard to the Rogers' Commission work and conclusions relative to our hardware not contributing to or causing the accident, we are in agreement with the Commission's findings. As stated above, our findings developed jointly with NASA/Marshall and independently corroborated by the United Technologies team showed that our SRB hardware did not contribute to the 51-L accident.

I will now answer your second question regarding recertification.

The design and verification of the SRB was performed by NASA/Marshall. During the contract evolution with USBI-Booster Production Co., the responsibility for new designs has been vested in our company but the original certification of the SRB was a NASA responsibility. We are using this opportunity to not only recertify the flight hardware, but to conduct analyses sufficient to allow the Booster Production Co. to certify the basic requirements, application of those requirements, and hence, hardware certification. To that end we have developed and are implementing an extensive program of recertification.

The recertification has three primary elements which follow a logical progression of evaluation. First, we will reestablish the basic design requirements from level II and level III. Second, we will establish: a verification program based upon those requirements. And third, we will reestablish that the design and the hardware are in compliance with the first two elements.

Key activities to be performed as we recertify the SRB will include the traceability of all the requirements into all levels of SRB design and system environments, verification of the SRB design data base and analyses, establishment of tools such as the failure modes and effects analysis, and validation that our paper systems have properly incorporated requirements, constraints, and criteria.

Within the scope of this recertification are many other tasks which are necessary to ascertain the status of the hardware, establish test and inspection criteria, and validate all of our subcontractors' processes, as well as those of the Booster Production Co. These activities comprise a long and tedious task that will require at least a year to accomplish. I will discuss the schedule in some detail later, but suffice it to say we are well underway on many of the major tasks and have a master plan leading to a design certification review with NASA/Marshall in April 1987. This master plan has been the evolutionary result of combined Booster Production Co. and NASA/Marshall thinking and within its scope are all the necessary elements for full recertification of the SRB prior to the next launch.

Regarding your third question, the Booster Production Co.'s ability to identify and respond to anomalous performance of flight hardware has been enhanced and reinforced in the last few years. Within our program management structure, we have subsystem managers who have many years of experience in the aerospace industry and who are assigned management responsibility for discrete SRB components and subsystems. Utilizing our quality assurance representatives and personal contacts with the key engineers at our subcontractors, these subsystem managers are made aware of anomalies beginning with the manufacture of the hardware and proceeding through Booster Production's processing of flight assemblies. Our launch support services [LSS] team monitors and tracks anomalies which may occur after transfer of the SRB to the shuttle processing contractor. This involvement by the LSS continues through all phases of assembly and test by the SPC, including countdown, launch operations, and recovery disassembly back at the Cape.

Postflight inspection is conducted by Booster Production Co. personnel trained to look for evidence of hardware wear and tear, offnominal conditions, or malfunctions. Postflight functional testing is as rigorous as that conducted on new hardware. Our HOSC team, meanwhile, is reviewing all countdown and flight data as part of the flight evaluation group, and is reporting and tracking all offnominal data on a daily basis with the Marshall Space Flight Center.

Postflight assessment telephone conversations are conducted daily between our LSS and our subsystem managers, engineering department, and the Marshall Space Flight Center. These conferences are the forum wherein all anomaly conditions are noted and actions assigned. Undergirding this entire overview by the subsystem managers is our problem report system which formally identifies and tracks all anomalies, develops trend data, and assures that corrective action is initiated and that recurrence control is proper and timely. This PR system interfaces with the NASA/Marshall problem assessment system. All functional failures and anomalies are then reported to the flight readiness review. Each subsystem manager is responsible for the review of his subsystem during the flight readiness review within the Booster Production Co. The flight readiness review process is then repeated at the project level with NASA/Marshall and the implications of anomalies which have occurred since the last flight are discussed in relation to the next flight. Engineering rationale as to flight worthiness is developed and presented by the Booster Production Co. to NASA/Marshall. We are a full participant in these flight readiness reviews and are active in the determination of readiness for flight.

In answer to your fourth question on design deficiencies and improving overall operating performance margins, part of the program we defined in preparing for the resumption of shuttle flight operations was the identification of design changes that would correct design deficiencies or improve our hardware operating performance margins. The program requirement for the SRB structural hardware is that the design, when analytically evaluated and supported by a static test, shall have a positive safety margin above the established factors of safety for the ascent and descent phases of flight.

I'd like to explain, in this context, that the ascent flight refers to the complete shuttle structure, while the descent flight refers only to the SRB following separation.

Ascent requires safety factors of 1.4 on ultimate and 1.10 on yield, and descent requires 1.25 on ultimate and 1.10 on yield.

As the program has progressed, two things have happened that have affected the initial analytical results. One, the loads have become better defined, which resulted in safety factor changes, both increases and decreases. And two, the analytical tools available today allow more refined studies of loads, distributions, and effects. As a result of these two factors, design changes are being proposed in several structural areas to improve both our safety margins and operating efficiencies. These changes improve the load carrying capability of the fasteners in the forward and aft skirts, as well as the external tank attach ring, and are the results of design improvements and corrections. The appropriate retention rationale

and inspection or test criteria is in place to accept and recertify the hardware.

Numerous design changes have been implemented to increase the operating margins as they relate to the reuse or multimission use of the hardware. Our knowledge of the SRB environments has increased, and as we have analyzed our hardware performance in these environments we have added design fixes to enhance or increase hardware life. These run the gamut from seat material changes in valves to vent cap modifications in the parachutes to structural reinforcement of the aft skirts through the use of gussets and foams.

In summary, we have implemented or have in process changes which we feel not only provide better operating margins but, in the case of the SRB, assure that the reuse of flown hardware will not degrade the performance or increase mission risk.

In answer to your fifth question regarding schedules, the recertification and design review of the SRB is a rather extensive undertaking. Our assessment of the time to complete this major effort of recertification for the next shuttle flight will be July 1987. Additional effort will continue in the area of extending the reusable life of the hardware and will not be completed until July 1988. And we will complete our failure-and-effects analysis, and our critical items list review will be completed in January 1987; the launch commit criteria in January 1987, all the OMRSD will be in November 1986, as depicted on the recertification schedule.

We at USBI-BPC are confident in the execution of the SRB recertification task, and our company is dedicated to its timely completion. We are firmly convinced that these reviews and revalidations will assure that the SRB hardware will perform safely and reliably as an element of the shuttle system.

I guess in summary, I can assure you that we are not complacent. We are using this opportunity to diligently review in detail the SRB requirements, specifications, procedures, processes, the certification, and verification documentation, both in-house and at our subcontractors. We will do whatever is necessary to assure ourselves and NASA of the SRB and our readiness to resume safe operations.

Mr. Chairman, I appreciate this opportunity to appear before you today and would be pleased to answer any questions you may have. Thank you.

[The prepared statement of Mr. Murphy follows:]

UNITED TECHNOLOGIES
USBI Booster Production Company, Inc.

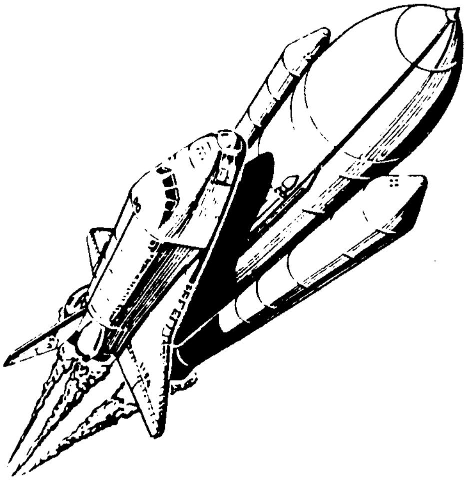
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Presented by Witness
July 15, 1986

Committee on Science and Technology

U.S. House of Representatives

Statement by:

George J. Murphy
Executive Vice-President
and General Manager



99th Congress

Statement of
George J. Murphy
Executive Vice-President
and General Manager
USBI-Booster Production Company

before the
Committee on Science and Technology
House of Representatives

Mr. Chairman and Distinguished Members of the Committee:

I am George Murphy, Executive Vice-President and General Manager of USBI-Booster Production Company, Inc. (USBI-BPC), a wholly owned subsidiary of United Technologies Corporation. Also attending with me today are Mr. Eugene Cagle the USBI-BPC, Solid Rocket Booster (SRB) Program Manager, and Mr. Don Reed, USBI-BPC SRB Chief Engineer.

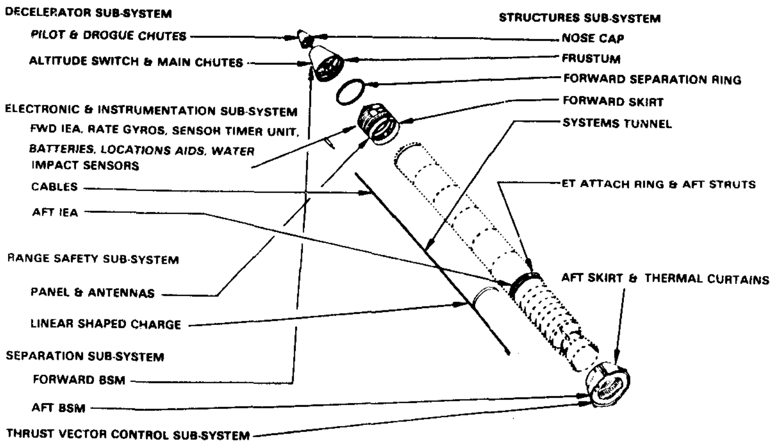
I am here today to provide the Committee an understanding of our contractual commitments in support of NASA's Space Transportation System (STS) Solid Rocket Boosters and to 1) assess the conclusions of the Rogers Commission as it relates to the SRB flight hardware for which USBI-BPC is responsible, 2) discuss the efforts that USBI-BPC has undertaken to recertify the SRB flight hardware, 3) outline the methods and analyses used to identify and respond to the anomalous performance of the flight hardware prior to 51-L, 4) explain what is being done or will be done to correct design deficiencies and/or improve the operating performance margins in SRB flight hardware, and 5) estimate the time required to complete the recertification task prior to flight operations being reinstituted.

First, I would like to give you some of the background defining our role in the Shuttle Program. The USBI Booster Production Company, Inc. and its predecessor company, United Space Boosters, Inc., have been under contract since December 1976, with the George C. Marshall Space Flight Center to assemble and refurbish Shuttle Solid Rocket Boosters for reuse (excluding the Solid Rocket Motor). The original contract required USBI to assemble, recover, disassemble and refurbish six (6) SRB flight sets of hardware designed and furnished by NASA/MSFC. The SRB hardware development and design verification had been performed by NASA/MSFC. Beginning with flight seven (STS-7), USBI also assumed responsibility for the procurement of the flight hardware. The initial contract required USBI to furnish a total of twenty (20) SRB flight sets to NASA/MSFC and our current contract provides for an additional sixty-four (64) flight sets

for an overall total of eight-four (84) flight sets. In January 1984, the SRB recovery and disassembly functions became the responsibility of the Kennedy Space Center Shuttle Processing Contractor.

The SRB has six (6) major subsystems, as shown on the SRB Pictorial, which are the responsibility of the USBI-BPC for procurement, refurbishment and assembly. These subsystems are Structures, Decelerator, Electronic and Instrumentation, Thrust Vector Control, Range Safety and Separation. Morton Thiokol provides the Solid Rocket Motor.

SRB PICTORIAL



In addition to the assembly, refurbishment and delivery of the described flight hardware, USBI-BPC also performs design and sustaining engineering. Liaison and launch site support are provided to NASA, Shuttle Processing Contractor (SPC) and Vandenberg Air Force Base (VAFB) to assure that a common understanding exists as pertains to system design, operational requirements and limitations of the hardware furnished, and to ensure compatibility of checkout procedures and anomaly resolution.

The following is in answer to your first question regarding the Rogers Commission work and conclusions:

Because of our mission responsibility to support the launch operations at KSC and the Huntsville Operation Support Center (HOSC) in Huntsville, our key managers and engineers were on station when the 51-L accident occurred. We immediately implemented the SRB Anomaly Investigation Plan at USBI-BPC and were on site in the HOSC to assist NASA/MSFC in the establishing and staffing of the SRB Contingency Team. Our personnel co-chaired six (6) subteams and provided technical expertise to formulate and plan the SRB subsystem investigations. We immediately impounded all 51-L related records and data. During the ensuing weeks of investigations, our personnel not only scrutinized the myriad of detailed records for 51-L, but technically challenged the design, Failure Modes and Effects Analyses, and potential SRB failure trees that could have contributed to the 51-L accident. United Technologies Corporate Office organized a multi-disciplined team of engineers to conduct an independent audit of USBI-BPC actions related to the 51-L assembly and test operations as well as review all engineering decisions relating to 51-L hardware disposition. We were pleased with our findings and those of the MSFC teams on which we served in that the SRB hardware provided by USBI-BPC for the 51-L was built and processed in accordance with the design requirements. The review showed that our systems of control were in place and functioned properly. In regard to the Rogers Commission work and conclusions relative to our hardware not contributing to or causing the accident, we are in agreement with the Commission's findings. As stated above, our findings developed jointly with NASA/MSFC and independently corroborated by the United Technologies' team showed that our SRB hardware did not contribute to the 51-L accident.

I will now answer your second question regarding recertification. The design and verification of the SRB was performed as a NASA/MSFC function. During the contract evolution with USBI-BPC, the responsibility for new designs has been vested in our company but the original certification of the SRB was a NASA responsibility. We are using this opportunity to not only recertify the flight hardware but to conduct analyses sufficient to allow USBI-BPC to certify the basic requirements, application of those requirements and hence hardware certification. To that end we have developed and are implementing an extensive program of recertification. The recertification program has three primary elements which follow a logical progression of evaluation. First, we will reestablish the basic design requirements from Level II and Level III. Second, we will reestablish the verification program based upon those requirements. Third, we will reestablish that the design and the hardware are in compliance with the first two elements. Key activities to be performed as we recertify the SRB will include the traceability of requirements into all levels of SRB design and system environments, verification of the SRB design data base and analyses, establishment of tools such as the Failure Modes and Effects Analysis, and validation that our paper systems have properly incorporated requirements, constraints and criteria. Within the scope of this recertification are many other tasks which are necessary to ascertain status of hardware, establish test and inspection criteria and validate all of our subcontractor's processes

as well as those at USBI-BPC. These activities comprise a long and tedious task that will require at least a year to accomplish. I will discuss the schedule in some detail later but suffice it to say we are well underway on many of the major tasks and have a master plan leading to a Design Certification Review (DCR) with NASA/MSFC in April 1987. This master plan has been the evolutionary result of combined USBI-BPC and NASA/MSFC thinking and within its scope are all the necessary elements for full recertification of the SRB prior to the next launch.

Regarding your third question, USBI-BPC's ability to identify and respond to anomalous performance of flight hardware has been enhanced and reinforced in the last few years. Within our program management structure, we have subsystem managers who have many years of experience in the aerospace industry and who are assigned management responsibility for discrete SRB components and subsystems. Utilizing our Quality Assurance Representatives and personnel contact with key engineers at our subcontractors, these subsystem managers are made aware of anomalies beginning with manufacture of hardware and proceeding through USBI-BPC processing of flight assemblies. Our Launch Support Services (LSS) team monitors and tracks anomalies which may occur after transfer of SRB hardware to the Shuttle Processing Contractor (SPC). This involvement by LSS continues through all phases of assembly and test by the SPC including countdown, launch operations and recovery disassembly back at the Cape. Postflight inspection is conducted by USBI-BPC personnel trained to look for evidence of hardware wear and tear, off nominal conditions or malfunctions. Postflight functional testing is as rigorous as that conducted on new hardware. Our HOSC team meanwhile is reviewing all countdown and flight data as part of the Flight Evaluation Group and is reporting and tracking all off-nominal data on a daily basis to Marshall Space Flight Center.

Postflight assessment telephone conferences are conducted daily by LSS with our subsystems managers, engineering department and Marshall Space Flight Center. These conferences are the forum wherein all anomaly conditions are noted and actions assigned. Undergirding this entire overview by the subsystem managers is our Problem Report (PR) system which formally identifies and tracks all anomalies, develops trend data, assures that corrective action is initiated and that recurrance control is proper and timely. This PR system interfaces with the NASA/MSFC Problem Assessment System. All functional failures and anomalies are then reported during Flight Readiness Review (FRR). Each subsystem manager is responsible for the review of his subsystem during the FRR within USBI-BPC. The FRR process is then repeated at the Project Level with NASA/MSFC and the implication of anomalies which have occurred since the last flight are discussed in relation to the next flight. Engineering rationale as to flight worthiness is developed and presented by USBI-BPC to NASA/MSFC. We are a full participant in these Flight Readiness Reviews and are active in the determination of readiness for flight.

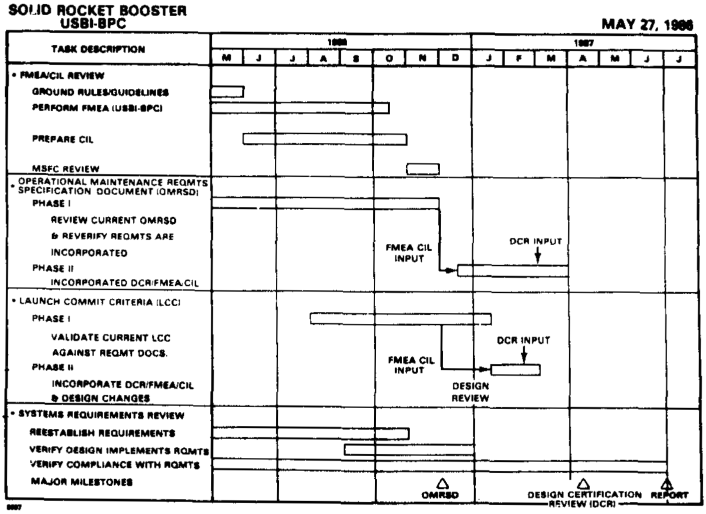
In answer to your fourth question on design deficiencies and improved operating performance margins, part of the program we defined in preparing for the resumption of Shuttle Flight Operations was the identification of design changes that would correct design deficiencies or improve our hardware operating performance margins. The program requirement for the SRB structural hardware is that the design, when analytically evaluated and supported by static test, shall have a positive margin of safety above established factors of safety for the ascent and descent phases of flight, Ascent requires safety factors of 1.40 on ultimate and 1:10 on yield, and descent requires 1.25 on ultimate and 1.10 on yield. As the program has progressed two things have happened that have affected the initial analytical results: 1) the loads have become better defined which resulted in safety factor changes, both increases and decreases, and 2) the analytical tools available today allow more refined studies of loads, distributions and effects. As a result of these two factors, design changes are being proposed in several structural areas to improve both our safety margins and operating efficiency. These changes improve the load carrying capability of fasteners in the forward and aft skirts as well as the External Tank Attach ring and are the results of design improvements and corrections. The appropriate retention rationale and inspection or test criteria is in place to accept and recertify the hardware.

Numerous design changes have been implemented to increase the operating margins as they relate to the reuse or multi-mission use of hardware. Our knowledge of the SRB environments has increased, and as we have analyzed our hardware performance in those environments we have added design fixes to enhance or increase hardware life. These run the gamut from seat material changes in valves to vent cap modifications in parachutes to structural reinforcement of aft skirts through the use of gussets and foams.

In summary, we have implemented or have in process changes which we feel not only provide better operating margins, but in the case of the SRB assure that the reuse of flown hardware will not degrade performance or increase mission risk.

In answer to your fifth question regarding schedules, the recertification and design review for the SRB is a rather extensive undertaking. Our assessment of the time required to complete the major effort of recertification for the next shuttle flight will be July 1987. Additional effort will continue in the area of extending the reusable life of hardware and will not be completed until July 1988. We will complete our Failure Mode and Effect Analysis (FMEA) and Critical Items List (CIL) Review by January 1987.

RECERTIFICATION SCHEDULE



We at USBI-BPC are confident in the execution of the SRB recertification task and our company is dedicated to its timely completion. We are firmly convinced that these reviews and revalidations will assure that our SRB hardware will perform safely and reliably as an element of the Shuttle system.

Mr. Chairman, I appreciate this opportunity to appear before you today and would be pleased to answer any questions you may have.

Mr. ROE. The Chair wants to thank the witnesses for extensive and solid testimony. We appreciate that; we think you've all presented an excellent overview of observations, and I think that all three of the testimonies, from the Chair's point of view, come down on specific items. And some of those items, we'll be asking a number of questions on. And I certainly want to mention to Mr. Jeffs, that you hit upon an extremely good point where some of the wags—or those who have all of the answers to everything—are saying that the space shuttle hardware and system is antiquated. And one of the decisionmaking processes that some people are leaning toward are, should we in effect scrap—yes, scrap—what we're doing now, instead of building a fourth orbiter, and take a "quantum step forward"—this is the quotation we hear—and develop a new, high-level technology. Could you respond in depth to that observation? You made the point in your testimony, from your point of view, in view of the ongoing process of constantly upgrading the different parts and pieces of the hardware as it becomes either affected in flight or improvements are made in engineering or technology; we're constantly updating, and therefore are not dealing in an antiquated technology.

Which is the—what is your observation to that?

Mr. JEFFS. Well, first, Mr. Chairman, I would be the first to encourage a continual look-forward into the future. That's what progress is all about and——

Mr. ROE. If the gentleman would yield, the issue before the committee that's been brought up by those people who have thoughts and processes going is that we should scrap what we're doing now, round out with the three orbiters, not build a fourth orbiter, put that energy and those resources into a second upgraded position and revolutionize the whole system and go to that area, and not to continue building a fourth orbiter. That's the question I want to ask you.

Mr. JEFFS. Well, of course, I violently disagree with that.

Mr. ROE. I thought you would.

Mr. JEFFS. I think what we should do is—obviously, we should continue the evolutionary process on the orbiters. They do the job, as I said; they have great potential; they don't need major change; they don't need major dollars to make any changes to them to perform the tasks that they not only perform on launch, but also in orbit.

I think that as far as quantum steps, such things as aerospace planes that we're actively engaged in, like others—as I say, they should be encouraged. We're looking at them, but that's why I made the statement in the first place, that the orbiter was the fundamental cornerstone of our Space Program for the next two or three decades because it's going to take that long before the next generation system comes into being.

Mr. ROE. The second question that the Chair has to ask is that we spoke of risks and time, which were part of the five questions that were propounded to you initially, and it seems to me that in reviewing Mr. Davis' and Mr. Murphy's testimony, they came back and made the point of view—and so did you, Mr. Jeffs—that with the criticality items involved—I believe there were 743; that sticks in my mind—748, is it? That's enough; we don't need to look for

any more—748, and the committee understands the relationship there. It seems to be that now that Dr. Fletcher has announced the reevaluation for the next flight to be—I believe it was July 1988—that that gives you an extra—not a whole year, but certainly gives you 6 or 7 added months for a more thorough reevaluation of the hardware as you referred to in some of the areas that you would have to put off otherwise because of the original projected date.

What about the point of view—I think what the committee is concerned about is that we're dealing with the criticality items—and we understand what you're talking about in criticality items—to encourage the contractors, all of the contractors, the hardware contractors, to review in toto all of those criticality items, the point you were making, and not just based upon simulations. In other words, we're talking, where at all possible, actual total field testing. Do you concur with that approach? Anyone? Mr. Davis? Let's try Mr. Davis.

Mr. DAVIS. Yes; I'd say I agree with that. As a matter of fact, I believe that's what all the program contractors are out doing at this point——

Mr. ROE. Well, there's been some tests—let me interrupt you—there's been some comments, and I just want to clarify it for the record, that there are some areas we could speed up part of the re-review by making simulation tests and so forth and not literally testing the materials.

Mr. DAVIS. Well, I can really only talk for the external tank——

Mr. ROE. I understand.

Mr. DAVIS [continuing]. And I don't recognize anything in that category for the tank. I'm probably not a good one to answer your question.

Mr. ROE. I understand that.

How about Mr. Murphy?

Mr. MURPHY. I think we feel the same way. We do not have that type of problem in the SRB hardware that we're responsible for.

Mr. ROE. Then it goes back to Mr. Jeffs.

Mr. JEFFS. I have most of the parts.

Well, as you know, the certification program on the hardware has been very rigorous throughout the program. We have qualified—for example, tiles to 100 missions with a factor of four, wherever we could. We do that with all the escape systems, the ejection systems, for example. We ran extensive tests at White Sands.

We do not incorporate systems in the vehicle unless they are proven and tested, and that includes the blades on the engines that I referred to. That's one of the reasons that I hedge a little bit on exactly when we can incorporate those into the vehicle. I believe we can do it by the 1988 period, but it's going to take a lot of certification testing, which we work out in great detail with the NASA from all angles; and then we run those extensive tests before we incorporate them in flight hardware. We always do that on the engines and we always do that in the orbiter. The same thing is true with the brakes; the certification tests on the brakes. For the escape system—before we put an escape system in there, we will run qualification testings on that escape system to make sure that it in fact adds to the safety of the system and doesn't in fact in any way detract.

Mr. ROE. Would you concur that there are other problems, other than the blades, in the turbo pumps and so forth, and the engine problems?

Mr. JEFFS. There are other problems on the engines.

Mr. ROE. What I'm trying to get at, with the extra year's time—which won't be a year if they are going to fly in July 1988; it's going to be lesser than that, but certainly more than we have now—can we get in depth into those areas, do you think?

Mr. JEFFS. Yes, sir. In fact, we do that every day.

Mr. ROE. The Chair will ask his third question and then start to defer to the other members.

You have all firmly but delicately danced around and discussed the issue of the shuttle processing contract methodology that was devised from 1983, as I understand the testimony, and correct me if I'm wrong. It seemed to me that you were saying—at least, as the Chair heard it—you were saying that "if I'm responsible for an integral part of the shuttle and its mechanisms, that I ought to be in on the entire processing of the parts that I'm supply to the very end to ensure that what we've done and the delicacy and the quality control of our production—that that is understood, No. 1, by other contractors, and handled properly; and the only way we really can do that is if we have some of our own key people shepherding that through to the final point of getting ready for launch." Is that a fair assumption that I'm making there, from the hearing of your testimony?

Mr. JEFFS. Yes.

Mr. DAVIS. Yes.

Mr. MURPHY. It certainly is from my point of view.

Mr. ROE. Then it comes back to me and it says that for some reason and for some purpose, somebody decided that the system could be improved—as of 1983—to go into a shuttle processing contract, somebody in charge of an umbrella over the top of it, what it appears to me and what I have re-reviewed of that system. Is that a fair comment to make? Somebody made that decision?

Mr. JEFFS. Yes.

Mr. DAVIS. Yes.

Mr. ROE. By the way, that contract runs about $1 billion a year—no, $1 billion, I beg your pardon, for 3 years, I think it is.

Why did that emerge? Do you feel capable—or should I be asking NASA? I suppose I should.

Mr. JEFFS. Well, I can give you my view.

Mr. ROE. Your view would be welcome.

Mr. JEFFS. Not having been in the circles in which those decisions were made or the reasons for them, but the way we viewed the problem was that the orbiter and the shuttle, in order to be cost competitive for the launch phase, have to operate frequently; that's the way to drive the costs down in launching. So the emphasis then is to try and work toward that end. One of the ways to do it is to incorporate, potentially, airline techniques—which we'd all been working on—to bring them more into the picture. To do this it was felt, I believe, that the declaration of the vehicle as operational in a very time in its maturity curve was an effort to, in fact, get those kinds of people into the hands-on doing of the job and have the development contractors back away, to cut down the

changes, and to hopefully reduce the time in working problems that may or may not have been considered completely necessary to fly.

So I think the fundamental of it is to turn it over to operational contractors and not the development contractors, who have the philosophy, then of quick turn-around, operate like an airplane, hand it over to the mechanics and not the engineers and the technicians so that in fact you could do that; operate it like a 747.

Mr. ROE. But the fact remains it's not a 747.

Mr. JEFFS. Well, it is hoped that we can eventually operate with much greater frequencies than we do, but it will never be like a 747. Space will never be routine. It might be frequent, but it will never be routine.

Mr. ROE. Mr. Davis, Mr. Murphy, any comments?

Mr. DAVIS. I would tend to agree with that. I think it was in an era when the program had experienced significant success with its flights; the flight rates were increasing; the program was looking to trying to get its costs down in the process. As a matter of fact, all of the development elements took on a productivity improvement program that was highly successful. One of the elements that was looked at was, indeed, how do you reduce the costs down at the Cape? And I think the people felt that the airline-type approach was an appropriate approach and ought to be taken. I think at this point I would say that events have shown that that was not the right thing to do.

Mr. MURPHY. I would concur with what Ric has stated. Basically, the motive of the operation at that time was to reduce costs on a highly effective and quality program, such that the orbiter had made many missions and came back in very good shape. However, the removal of the engineers out of the dominant role, I think, and replacing them with the standard universal technician concept has not been advantageous to the program, and I think it should return to the engineering element in which it obviously still remains.

Mr. ROE. So are we saying in summary, then, on this issue, from a management point of view and from a safety point of view and from a quality point of view, that the key people in the different hardware companies that were involved were taken out of the final chain, if you like, of decisionmaking in a host of areas? It appears to me to be that way. Is that a fair commentary to make?

Mr. JEFFS. I think that—decisionmaking, and also accountability for the hands-on preparation of the vehicle.

Mr. ROE. So basically what we're saying, that area needs total rereview so that the contractors and the engineers and those people that are responsible for the intricacies of the parts involved are carried right through—their decision and their cooperation is carried through to the very end, to the launch itself.

Mr. JEFFS. Yes, sir; but in full recognition of the objective of eventually getting the vehicle to a more frequent operational configuration time-wise, and charge the development contractors with recognizing that as a goal and bringing to bear that as a possibility as soon as possible.

Mr. ROE. When Mr. Jeffs spoke to the ice issue and gave an explanation on the ice issue, had that procedure been followed and we had not gotten into the shuttle processing approach—the um-

brella approach—might it have been that your company would have suggested that they did not fly at that point?

Mr. JEFFS. Sir, I——

Mr. ROE. Would it have been heard more loudly, do you think, at that point?

Mr. JEFFS. Say again?

Mr. ROE. Would it have been heard more loudly in the decision-making process?

Mr. JEFFS. I really don't think that that was the problem, of not hearing us loudly, Mr. Chairman. I really can't say how we would react in that because I am not privy to all information that the program manager did have to make his decision.

Mr. ROE. I understand that.

Mr. DAVIS. I would like to comment on that.

Mr. ROE. Mr. Davis.

Mr. DAVIS. I don't think that really the SPC affected our ability to be heard. I think at any time we could have been heard. What it affected was our visibility of what was happening with our hardware.

Mr. ROE. Maybe they would have heard, but you didn't have a total view—from what I understand from your testimony—of what the overall picture was. You were not subject to the overall view, isn't that so?

Mr. DAVIS. Correct. It was the visibility of what was happening that was missing, not our ability to be heard if we had the knowledge.

Mr. ROE. Part of the Commission's finding and part of this committee's finding already has to do with—it's not only the hardware that's our concern; it's the other issues that have to do with the management process, so that Macy knows what Gimble is doing.

Mr. DAVIS. Right.

Mr. ROE. The Chair recognizes the distinguished gentleman from Florida, our chairman, Mr. Fuqua, for any questions he may have.

Mr. FUQUA. I have no questions, Mr. Chairman. Thank you.

Mr. ROE. I thank the gentleman.

I guess we'll skip you, Mr. Walker.

The gentleman from California.

Mr. PACKARD. Thank you, Mr. Chairman

Let me ask Mr. Jeffs a couple of questions, then ask for a response from others of the panel.

The brakes and the landing and the steering systems have been an ongoing problem; not, certainly, uncovered only in the accident. In fact, it had nothing to do with the accident, but I was present when we saw several tires go and the braking system was obviously a problem.

In your redesign of the brakes—and I think you've indicated in your testimony that you are reworking the brakes now, according to your written testimony, upgrading features to increase stopping capability from 42 million foot-pounds to 65 million foot-pounds—in these redesigns is it intended now that those be installed before we fly again?

Mr. JEFFS. Yes, sir. The upgrade to the 65 million foot-pound capability.

Mr. PACKARD. In your judgment, will that solve the braking problem that we've historically had?

Mr. JEFFS. Well, that will solve the braking problem with respect to unacceptable limitations at landing sites—for example, permit landing in cross-winds at such sites. As far as KSC is concerned, we still have a problem relative to the fact that the brakes would do the job, but perhaps the tires won't handle it with the rough runway. So that's where the nosewheel steering comes into play because it reduces the amount of braking you have to do in order to keep the vehicle on the center line of the runway. So the brakes coupled with the steering, even with the existing tires, I believe, would eventually handle the problem at Vandenberg, but it's going to take nosewheel steering to minimize the braking required, even though the brakes are capable of handling the energy that would be involved.

Mr. PACKARD. Is the braking system as currently designed running into greater problems at the Cape than it does at Vandenberg, and at Vandenberg greater than it does at Edwards?

Mr. JEFFS. Well, of course, we haven't landed at Vandenberg, but the runway surface is more forgiving; it's smoother at Vandenberg than it is at the Cape. The Cape is a very rough runway for reasons of minimizing any hydrostatic problems, and it also gives a very good rolling coefficient of friction, which is what we want to have at the Cape because we don't want in any way to roll over that runway or overrun that runway. So I think that the general answer is that Vandenberg is a more forgiving runway, that the new brakes would take care of that problem even without nosegear steering, I would expect. The Cape—we may have to have nosegear steering because of the roughness of the runway and interaction with the brakes and tires, and the 65 million foot-pounds certainly takes care of the cross-wind situation.

Mr. PACKARD. Mr. Jeffs, we've never had to land in an emergency situation. Would the brakes, as redesigned, and the tires as currently designed, be able to handle an emergency landing of the shuttle with a full payload aboard?

Mr. JEFFS. Well, I believe so. But I think, for belt and suspenders, the NASA is also looking at arresting systems at such sites.

Mr. PACKARD. Thank you on that question.

You spoke also of the escape system. I presume you're referring to the escape system for the crew?

Mr. JEFFS. Yes, sir.

Mr. PACKARD. Is not that considered to be an impractical part of the shuttle? Are we still seriously looking at an escape system?

Mr. JEFFS. Yes, we are looking at an escape system, particularly for that phase of flight that relates to water ditching. If in fact we have to water ditch, we're concerned about the survival of the crew, so we are looking at a way to set up the vehicle in flight so that the crew would have time to get out of the vehicle. And the next big step is the tough one, and that's how to develop and how to build and certify a practical system to get them out, and this would occur anywhere from 40,000 to 50,000 with oxygen assist on down to the water.

We have certainly not given up on it. We have a number of ideas, and we are working hard. So far we don't have a final approach to recommend.

Mr. PACKARD. But primarily, we're looking at water escapes——

Mr. JEFFS. Water ditching.

Mr. PACKARD [continuing]. Rather than during launch?

Mr. JEFFS. Yes, sir.

Mr. PACKARD. Thank you.

Mr. Davis, you spoke regarding the companies having a voice in the decision-making, I presume, after the FRR's, that two-week interim between launch and the readiness review system. Do you believe that the companies should have more voice, less voice, or have they had any voice in whether it's a go or a no-go?

Mr. DAVIS. Well, I can tell you how it runs now. Up to and including the L-minus-one-day review, there's no doubt that every company has a very strong voice; and, as a matter of fact, at the L-minus-one review, they are required to stand up and commit their hardware as go or no-go. And those are very unequivocal commitments, also.

After that time, then the reviews are more mission management meetings that are held, and as you get down into the countdown, it turns into more of a real time polling of the people that are actually controlling the launch.

In those latter meetings we are not, I would say, formally involved in those unless there is some problem with the hardware itself, the external tank hardware. We are in firing room 2 in a very significant presence; we are aware of what is happening in some of the consoles. We sit behind them; we do not operate them. We are polled by the Director of Engineering prior to the launch actually proceeding, so we are sort of polled in an informal manner. We are not asked at any time after the L-minus-one for a formal go or no-go.

I believe it would probably be appropriate, in terms of the Commission's desires, that indeed we be more formally involved in the mission management meetings, and that at some appropriate late time in the launch count—and I would leave that to NASA to decide—that indeed the companies be asked to declare go or no-go.

Mr. PACKARD. A quick answer, Mr. Murphy. Do you agree?

Mr. MURPHY. Yes, I agree with what Ric has said. I think that we have found out that we commit ourselves, I guess, at 20 minutes and 9 minutes by the people who are manning the consoles, but it does not arise to the management level which it should, in accordance with what Mr. Davis has stated. We would like that opportunity, also.

Mr. DAVIS. I'd like to make one other comment on that. I have never felt that if I needed to stop a launch, I could not stop it. While I have not been asked for a positive go or no-go, the ability is always there if I decide no, to stop the launch.

Mr. PACKARD. Mr. Jeffs, do you feel the same?

Mr. JEFFS. Yes, I think the system should be formalized more. We have great visibility as to the problems and real times, being on the net and having CRT's and people that are involved in it in depth, both at Downey and at Houston, who support it, even though it's at the Cape. But especially, when you have holds or

delays and what have you, it needs to be—again—upgraded in real time with, I believe, the contractors' participation with NASA management right up to the launch decision point, and a little more formal process involved in the polling of the contractors.

Mr. PACKARD. Mr. Murphy, if you'd had that system set up prior to the accident, would the flight—would it have still gone?

Mr. MURPHY. It would not have influenced our position at all. Our hardware—we had stipulations on what we required on the hardware during the whole period. They were met, and so we were in a "go" posture as far as we were concerned. It would not have affected our position.

Mr. PACKARD. One last question, Mr. Chairman, if I may.

We know that the SRB's, Mr. Murphy, were not adequately temperature-certified. There was obviously considerable—much of our testimony of the last few weeks has been regarding the O-ring, its ability to adapt to—or inability to adapt—to cold weather and the cold weather problems that existed on the morning of the flight.

It was reviewed by a whole bevy of experts, and still it was not determined to be reason enough to cancel the flight. In redesign what will be done, do you think, differently than what was done in this case that will protect from a similar situation existing?

Mr. MURPHY. Well, you know, the temperature relationship primarily has to do with the SRM, which is not our responsibility. It is the responsibility of Thiokol. The SRB hardware, as far as we're concerned—we're low-temperature qualified to meet the criteria of that day. We were not associated with the SRM, so what is being done in that matter to recertify that hardware is strictly up to that contractor.

Mr. PACKARD. Is it, in your judgment—is the solution to the cold weather going to be—and in the redesign—is it going to be to adapt and be able to fly under cold weather conditions, sub-freezing conditions, or is it going to be to just simply fly no flights below 50 degrees or something?

Mr. MURPHY. Well, of course, I'm not really qualified to make that commitment because it's not our responsibility. However, they are planning on having a heating capability at Vandenberg. I can see no reason whatsoever they could not have a heating capability at the launch site at KSC so that the temperature would not become a problem.

Mr. PACKARD. Would that correct temperature problems after launch?

Mr. MURPHY. Yes—it would correct the launch temperature, and that is the primary concern.

Mr. PACKARD. That is the—there is not a temperature problem once they move away from the atmosphere?

Mr. MURPHY. Not that I perceive.

Mr. PACKARD. That's all I have, Mr. Chairman. Thank you.

Mr. ROE. The Chair recognizes the distinguished gentleman from California, Mr. Brown.

Mr. BROWN. Mr. Murphy, I'm not quite clear where your responsibility and Morton Thiokol's begin and leave off. Could you explain that in fairly simple terms for me?

Mr. MURPHY. Yes; we primarily have all responsibility for all of the SRB hardware, with the exception of the solid rocket motor.

We procure all of the structure hardware; we procure the thrust vector control system; we procure the booster separation motors; and basically, we assemble all this hardware primarily in the nose cone and the frustum. We assemble the parachute system. In the forward skirt we assemble the electronics, the IEA's; and then the aft skirt holds the thrust vector control system and the actuators and the booster separation motors, located both in the aft skirt and in the frustum. That is the hardware that we procure. We assemble it; we check it out. And at that time, as far as we're concerned, that hardware has performed as designed and we in turn transfer that to the Government, to the shuttle processing contractor, who is responsible for stacking that hardware, along with the solid rocket motor, into a solid SRB. We only have an observation-type responsibility once we transfer the hardware across the aisle, and that is one of our concerns, that we have not had the visibility that we would like to have under the present SPC arrangement.

Mr. BROWN. And Morton Thiokol, then, has the responsibility for the solid rocket motors?

Mr. MURPHY. Yes; and additionally, when the solid rocket is separated and is recovered again, the SPC recovers it, brings it back in, and separates it, and we get our hardware back—the frustum, the forward skirt, and the aft skirts—to tear down and determine the wear and tear on the hardware and start the refurbishment activities at that time.

Mr. BROWN. When Mr. Fletcher announced that we wouldn't be able to launch again until the first quarter of 1988, I think he announced that it was based upon the new estimates of the design for the solid rocket motor. Is that right?

Mr. MURPHY. I think the solid rocket motor has an influence on it in the testing required to verify it, yes.

Mr. BROWN. I'm very much concerned, and I think everyone concerned with the program is concerned, about this long delay in the launch time. And I was looking at each of your testimonies from the standpoint of how you felt about being able to fly again. And Mr. Jeffs, you said that you could complete your work in 18 months, which—I don't know when you start counting, but if you start counting from today that would bring us into the first quarter of 1988, wouldn't it?

Mr. JEFFS. We've already started on the valves. So the first quarter of 1988, if we incorporate the locking feature and the 17-inch disconnects—we've been flying without that locking feature, and we've had confidence in this system when properly rigged. We could fly it now without the locking feature.

Mr. BROWN. So from your standpoint it would be possible to fly earlier than that date?

Mr. JEFFS. Yes, sir.

Mr. BROWN. And Mr. Davis, you didn't feel there were any problems in flying by July 1987?

Mr. DAVIS. That's correct.

Mr. BROWN. And the same with you, Mr. Murphy?

Mr. MURPHY. Yes, sir, that's true. Our certification schedule permits us to fly at that time.

Mr. BROWN. So the limiting item then is the redesign and then the remanufacture of the solid rocket motor. Is that—I'm just trying to understand this.

Mr. MURPHY. That is my impression.

Mr. BROWN. It's just an impression, though? You're not sure?

Mr. MURPHY. Well, I do not know the schedule for the SRM fix and the testing techniques at this time. But I've got to assume, since the other elements of the shuttle are ready to launch, it has to be associated with the solid rocket motor.

Mr. BROWN. Is there—well, it wouldn't be appropriate to ask you gentlemen whether or not we could beat this schedule, because as far as you're concerned we could. Is that my understanding from all of you?

Mr. JEFFS. Yes, sir.

Mr. BROWN. This obviously enters into some of the policy discussions about which way we go with regard to a fourth orbiter and so on, but this rather lengthy delay casts a cloud on many aspects of the program, including—I suspect it gives a better case for not building a fourth orbiter and proceeding with the three that we have, and then hoping that we'll get another generation of vehicle, the national aerospace plane or something of that sort. And I concur with the feelings that I think you've all expressed, that we should proceed with the fourth orbiter, and I'd like to identify how we could make the best possible case for that.

I have no further questions, Mr. Chairman.

Mr. ROE. The Chair recognizes the gentleman from Pennsylvania, Mr. Walker.

Mr. WALKER. Thank you, Mr. Chairman.

I was not here for your testimony but I understand that all of you have testified that you're going to requalify your hardware; and, in the case of the orbiter itself, there are going to be some fixes that are going to take place and that in each case, if you find things that are problems during the requalification, that you would do the fix.

Can each of you give me an estimate of how much it's going to cost NASA for the particular work from your company to be done? Mr. Jeffs, in particular, you have brakes to do, a whole bunch of things that are going to have to be done to the orbiter. Do you have a cost estimate as to how much that's going to cost us?

Mr. JEFFS. Well, as you know, the brakes have been in work for some time. As a matter of fact, the designs have essentially been released.

What we're going to do in total in the way of fixes, because there are a lot of small changes that are introduced in the system, is going to be dependent upon the NASA's review of those and the determination of which of those are going to be incorporated. We have not prepared cost estimates on those numbers yet, and I would prefer not to give you a wrong or a wild estimate on it. I'd rather submit for the record subsequently what the dollars are going to be associated with the changes that are accepted.

Mr. WALKER. Well, you've given the committee, though, the 17-inch external tank orbiter disconnect; the brakes; the APU fuel isolation valves; the reaction control system, and the avionics system.

All of those, you say, are going to be done to support the next flight.

Mr. JEFFS. Yes.

Mr. WALKER. Now, what's the cost of just those?

Mr. JEFFS. I don't have a number, sir. I'm going to have to get it separately and submit it to you. We have not generated the detailed cost numbers on each one. You know, they vary—the gamut. The avionics system, as far as the chips are concerned for the MDM's, is going to be a relatively small item; probably, I expect, a very few million to retrofit those particular MDM's. And I don't know, on the reaction control system, exactly what kind of disassembly we have to go to in order to get the thermocouples on the system.

The cost estimates have not been generated as yet. They are in the process, as I say.

Mr. WALKER. I think, based upon what we are going to have to be doing as a committee, it would be very useful if we could get some idea of those cost estimates, so I would appreciate as a part of the record of this committee that you would submit at least the cost estimates that have been worked up to this time so we can get some idea as to what all this is going to cost because we're very likely to have NASA coming in here suggesting to us that we've got to come up with the money. So it's going to be very, very important to us to get some idea as to what all these costs are going to be.

Mr. JEFFS. We will see to it that you get the numbers that you request. I would caution that we submit the numbers to the NASA; sometimes the things that we do on the vehicle interact in other areas with a system that require NASA to add different dollars onto it, that we haven't got the visibility of, so the total dollars would really come from NASA to you on these particular fixes. We'll make sure that we get ours in to NASA and that they know of the request as soon as possible.

Mr. WALKER. Well, I understand, but it's very important to us to get some idea of what these costs are going to be.

Mr. Davis, do you have any idea of what the costs——

Mr. DAVIS. We're essentially in a similar position. We're assessing the costs and getting ready to submit new estimates to NASA, and we will essentially comply in the same manner as Rockwell.

Mr. WALKER. Mr. Murphy.

Mr. MURPHY. I believe that our complete redesign certification—and depending on what is found during that design certification—could influence the costs that we are looking at. I think at the present time right now we are looking probably at about a $60 million effort.

Mr. WALKER. At $60 million? OK. I thank you. And, Mr. Davis, as soon as you submit those costs to NASA we'd like to have those costs, too, so that we would know what that figure is.

[Material was not available at press time.]

Mr. WALKER. Mr. Jeffs, where do we stand with regard to the new orbiter, with engines? I'm looking for some idea as to how long it would take us to do that, what's your latest guess as to how long it would take us to put a new orbiter on line with engines in place, and how much would it cost us?

Mr. JEFFS. Well, sir, we have submitted those numbers, as far as the Rockwell numbers are concerned, to the NASA. The time estimate was about three and a half years. We are starting with a jump on the process, as you know, because we do have structural spares that we can assemble into that orbiter, most of which we've received except for the wing.

Mr. WALKER. Three and a half years from the time that we commit?

Mr. JEFFS. Three and a half years from the time that you commit and I turn the lights on in Palmdale. I think we can beat that. I think we can do it a little faster than that——

Mr. WALKER. That's with engines?

Mr. JEFFS. That's with four engines to support.

Mr. WALKER. And what's your latest cost estimate?

Mr. JEFFS. The numbers that we submitted—Rockwell dollars, now, and not added numbers that get into the system because of suits and other things that the NASA has to add to it——

Mr. WALKER. I understand.

Mr. JEFFS [continuing]. Just the Rockwell estimate was $1.85 billion, of which about $420 million had already been spent for structural spares. So it's a net of the difference of those two numbers.

Mr. WALKER. So it's somewhere in the range of $1.4 billion?

Mr. JEFFS. Yes, sir.

Mr. WALKER. The Commission also called upon NASA to restore the spare parts program and to make certain that we don't have to cannibalize one ship in order to fly others. How much is it going to cost us to restore the spare parts program?

Mr. JEFFS. Well, we have given the NASA a plan for getting the spares program up on the step; and, of course, this time delay period gives us a chance to replenish the stock. And also, it's a function of the numbers of flights a year as to the total stock you have to put together.

I believe those numbers are part of the basic NASA plan, and they are something on the order of—the numbers that I recall were about $250 million for 3 years, starting in 1987. But those were, in good part, part of the basic plan that NASA has now accepted as the logistics program.

Mr. WALKER. That's very helpful.

One final question. Are your subcontractors still capable of producing the spare parts? In other words, are the subcontractors in place and capable of carrying out a spare parts program in that kind of a restoration?

Mr. JEFFS. Yes, sir. The spares program has helped us maintain a good part of that base. It won't be long before we're going to start losing a few of the subcontractors; I would say another four to five months and we'll start dropping off contractors that we will not be able to bring back, and we'll have to start out with new parts.

So the basic answer to the question is, between NASA and ourselves, we've maintained that base but it's not going to be far from starting to disappear on us, timewise.

Mr. WALKER. And if in fact the subcontractors start to disappear, it will be entirely more costly than the $250 million a year that you quoted to me just a moment ago, wouldn't it?

Mr. JEFFS. Well, yes, sir; I think that would have a graduating effect into the cost. It does amplify because redesign is required; sometimes that reflects back up into the rest of the system.

Mr. WALKER. And would that begin to add costs to the production of a fourth orbiter as well, if you lose some of those subcontractors?

Mr. JEFFS. If we let it go too long, it could. I would say that if we let it go for another 6 months—or over 6 months; beyond about 6 months—I would say we're going to start getting into a lot of additional redesign.

Mr. WALKER. Thank you, Mr. Chairman.

Mr. ROE. I thank the gentleman from Pennsylvania.

I want to thank all of the witnesses, but I think I want to get on the record one more item.

You mentioned, Mr. Jeffs, that the—I believe it was you that mentioned it—it would probably take three and a half years to literally build the fourth orbiter, but you also made a comment during your testimony, and I want to just reiterate it, that we're really in the generation now, and we're talking another 10 years or 15 years as we go through the experimentation work we're doing and particularly get into the space station program, which is geared to the shuttle issue. So that it's profitable as far as the Nation is concerned, that the quickest way and the most cost-effective, the most risk-free way to get back into space is to go in the direction of building the fourth orbiter so that at least we have that system as our contemporary system while we're looking to the future. Is that a fair statement for all of you to make, Mr. Jeffs, Mr. Davis, Mr. Murphy? Do you all see it that way?

Mr. JEFFS. Yes, sir.

Mr. DAVIS. I would certainly agree that using our current system is a much safer and a much more cost-effective way to go than starting out on a new development, like an aerospace plane.

Mr. JEFFS. It works. It does its job very well.

Mr. MURPHY. The Russians are still using Soyuz.

Mr. ROE. Well, I think it's important to say—I see, with this delay issue—and the second leg of the question I want to ask you, the space program is a different program, really, of anything else we're doing where expertise is involved. That doesn't mean we're not using a series of different discipline engineers and scientists and so on, but the coordination of the program to literally make the launch and sustain the launch is a very special, special area indeed in the engineering world, I would say, from my observation.

One other thing that concerns this Member is that if we putz around too long, and people are afraid to make a decision—whatever the reason for that may be—taking in full consideration that safety is number one, as you've all testified to, that we could start to lose highly promising and highly trained personnel. And that's also an integral part of the whole system because if you don't have the hands and the minds to make and fabricate and design the equipment, it's not going to be done anyway. Do you share a concern? Are your companies starting to lay off people and to curtail advanced employment as far as new engineering crops are concerned, coming from the universities? How do you see this affecting

the whole basic industry as far as personnel is concerned and delay and rebuilding our expertise? Anybody want to comment to that?

Mr. JEFFS. Well, I guess we've got probably the biggest problem. It is a concern with respect to the total space team, and that's the Government and the industry side.

Mr. ROE. That's what I'm talking about.

Mr. JEFFS. We have a lot of work to do in the spares program that you identified, in going through the changes activity that we're going through now on both our engines and the orbiters. We can pretty well sustain a fundamental capability, clearly, for a year. A year after that, though, our forces are going to start dropping down, particularly in the orbiter area, and they are going to threaten our——

Mr. ROE. That's precisely the point I'm trying to get at. The debate—if the gentleman would hold—the debate at hand is whether or not we go with the fourth orbiter, and all the reasons and all of the discussions we've had and all the witnesses, including yourselves, up to now—and you're making a very telling point, that unless that decision is made someplace along the line in the reasonable future, that's going to exacerbate the time in the whole system as far as we're concerned. Does that make sense?

Mr. JEFFS. Yes, sir, and that's the team, between NASA and Rockwell, that is essentially the foundation for the present manned space program.

Mr. ROE. That's exactly where I'm coming from.

So we're not just talking about extending a year. What we're simply saying, that if the fundamental, basic decision isn't made to go ahead with the fourth orbiter as quickly as possible, the year extension that Dr. Fletcher has talked about could extend way beyond 1988, potentially. Is that a fair commentary to make?

Mr. JEFFS. Yes.

Mr. DAVIS. I might comment that probably my situation is a little more unique in terms of the fact that we are an expendable unit. And actually, the long extensions essentially threaten further layoffs of qualified people that you need to build the safe hardware. And certainly, the long extension is not in our favor nor in the Nation's favor for us to allow that to happen. It takes a good period of time to take a laborer, train him, certify him, get the mission success culture imbued in him, in order to produce safe hardware. So the longer we go and the more we lay off people, the worse it's going to be trying to get back on line with safe, good hardware.

Mr. ROE. Mr. Murphy.

Mr. MURPHY. We're a little different, somewhat. We have, of course, experienced layoffs like everybody else, but the layoffs have primarily been in our technician area.

With the recertification and the activities associated with the hardware that we have already put together—obviously, that hardware is going to be given back to us. We're going to take it down and modify it and build it back up again. So between that and the recertification program, I do not see a loss of our engineering skills within the immediate future. I'd say we have sufficient tasks to keep those skills around for at least two to three years.

Mr. ROE. OK.

The Chair recognizes the gentleman from Florida.

Mr. NELSON. Thank you, Mr. Chairman.

Gentlemen, good morning. I want to get some additional information about the decision to launch, either a go or a no go. Can you share with me your past experience about where you have given input and NASA has disagreed with that input, either no launch or the opposite of launch, where you were giving the opposite advice? Can any of you share with us that previous experience?

Mr. DAVIS. I can share that pretty rapidly. We have never disagreed with NASA relative to a launch or a no go. I also felt that if indeed NASA felt that they were going to launch over my objections, that I had every avenue open to me to try to prevent that.

Mr. MURPHY. We have not experienced that problem either and do not pretend to experience it. Our relationship is very direct and we would have no problem at all, I'm sure, of stopping a launch if necessary.

Mr. JEFFS. I don't really have any problem with that, Mr. Nelson. I remember no situations where they haven't listened to what we had to say and taken appropriate action, and that includes the recently discussed icing problem.

Mr. NELSON. Well, except on January 27 and 28. You had a disagreement there.

Mr. JEFFS. I went through that earlier, Mr. Nelson, when you were out of the room. But I think we had a difference of technical assessment of the depth of the concern relative to potential damage to the tiles. We did not have a go or no go; we had a strong concern lest there be damage to the tiles from the ice source. We've experienced ice source problems before from ET, as you well recall, so there's been experience with ice damage on the tile system. We don't like it. We try to avoid it; that's why we spend so much time and effort—all contractors—to clean up the ET. We didn't know where the ice was going to go, and that was our concern. NASA had separately analyzed the problem; they were concerned about it too, but they did not feel that it was going to be a mission or safety issue relative to potential impact to the tiles, even during the aspiration and the liftoff. So I knew they knew that, and they knew I knew that.

Mr. NELSON. I apologize for not being here. I was outside meeting with Dr. Fletcher on another matter.

Let me just ask you this. In your conversations regarding ice and the potential hazards, did anyone ever bring up the fact of it being slippery on the launch tower in case an emergency egress had to be made to get out of there and get into that wire basket?

Mr. JEFFS. Well, I was not in on the decisionmaking process; and, as you know, it's not our responsibility relative to those kinds of issues on the pad. We didn't have the visibility. We were looking at it from Downey, so I don't know. However, I think it certainly is a concern in retrospect.

Mr. NELSON. You're not aware of any particular conversation——

Mr. JEFFS. No.

Mr. NELSON. All right.

Do you all individually, representing your companies, feel that you have sufficient input in the flight readiness review or any of

the other meetings that get right up to the L-minus-one meeting, that your input would be sufficient in the past to delay a launch?

Mr. JEFFS. As I think most of these witnesses have stated—I've certainly stated—there's nothing stopping us from calling program managers or center directors or the Administrator if we feel that we have a problem and we have the visibility to see that problem. I think that the process should be formalized a bit more, and the contractors should be asked to formally state their position all the way through the process up to launch because, as you know, when things recycle things get a little confusing. And so I believe that it should be formalized to a better degree, but there's nothing right now that prevents us—or ever has—from expressing our views.

Mr. DAVIS. I would tend to agree with that. I think, as we discussed while you were out, it's not the process or the accessibility to make those recommendations. The thing that has concerned us with the SPC is our lack of visibility with some issues relative to our hardware that then gives us the knowledge to make some recommendations.

Mr. MURPHY. I have to agree with that. I think that in the lack of visibility for the SPC activities, we are not as comfortable as we would like to be before the launch because unless there is a breakdown of the OMRSD or the critical launch criteria thing, the problem is not necessarily brought to our attention. And we think it should be.

Mr. JEFFS. Mr. Congressman, if I might add to that from our views. We see, right up to the last minute, the functioning hardware and whether there's anything going wrong with it, and that's where we can get in the act and contribute. But like these gentleman have said, we also have the concerns that we don't know exactly what's happened to every tile on the vehicle, for example, whether it's been full test verified after installation and that sort of thing. We don't have that visibility any more; that's somebody else's, and that's the kind of thing that makes us nervous relative to being able to account for all aspects of our hardware being ready to fly.

Mr. NELSON. Let me shift to another subject. The Commission had a recommendation that a shuttle safety advisory panel should be established, and it should report to the STS program manager. What are your agreements or disagreements or comments about that recommendation?

Mr. JEFFS. Well, we have no objection to added elements in the system that would further the focus on safety. However, safety is not going to be built into the system by another panel; it's going to be built in by every man and woman of us that work on it, right down to the lowest level. So it's the technicians, the engineers, the managers, and all of us that are responsible and accountable for that safety. To have another group that tends to remind us of that responsibility from time to time won't hurt a thing, but the accountability has to be on those that are doing it and not those that are overviewing it.

Mr. DAVIS. I tend to agree with that. I think I pointed that out in my testimony, that the responsibility has to remain squarely on the NASA projects and the contractors to commit for the safety of the launch.

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Mr. MURPHY. I have to concur with that. I don't have any other comment than that. I think that motivation and discipline are going to provide the safety that's required.

Mr. NELSON. OK.

Finally, Mr. Chairman, with the SRB joint having been the problem for this terrible tragedy, along with all the other things that the Presidential Commission has come out and identified as the problem, looking back on how the whole system functioned we found out that there were a whole bunch of people involved in the SRB design and the certification process. There were the internal groups at Thiokol; there was the oversight by Marshall; there was a thorough review by an outside group, headed by Dr. Williams; there was the Aerospace Safety Advisory Panel; there was the certification process and signing off, but for the first shuttle flight, STS-1; and then there was that same certification process and signing off again that occurred before STS-5.

Now, still, all of those problems went undetected by so many groups. So what is your recommendation to us as we now oversee the shoulder of NASA, give it guidance, see how the implementation of the Rogers Commission report is going, so that we have the confidence that the current redesign and certification process is going to be made so that we know that it is relatively safe when we start to fly again? And I say "relatively" understanding—all of us understanding—that space flight is inherently risky.

Can you comment on that?

Mr. DAVIS. We can only comment on our own systems because those are the ones we know of. But certainly, from the external tank viewpoint, we found the system to be rather thorough. Now, I think you've got to realize that it takes both contractors and NASA to make that system work, and some of the things that are being done different that I think will help—as I mentioned, Marshall Space Flight Center has contracted with other companies for independent FEMA/CIL assessments of their hardware. In particular, Rockwell is doing a total independent assessment of my external tank hardware, and I think that's well looked-to. I look to their expertise to question everything we did and maybe give us some advice on how to make it better.

I think the other thing I would recommend is that the processes set up, the flight readiness processes, are all structured with certain criteria to look at things, and so forth. Those need to be reevaluated, what are you looking at, why are you looking at it, what questions are being asked, and I think with some of the lessons learned from this tragedy I think we can maybe ask some harder questions, tougher questions. Some of the issues—are we satisfied with a rationale that says, "Well, it takes a double failure to cause this to happen"—questions like that—is that adequate for crit-1 items? Those types of things, I think, are in the process of being done and will give us the additional confidence in the future.

Mr. JEFFS. I have something to add to that. I don't have any quarrel with those points; however, I think that it's a further argument to make sure that the development contractors stay in the process more deeply, including in-depth the activities at the cape. The system is not yet fully operational; we're still learning about this system. When we see little signs—and I'm not suggesting that

the blow-by on the seals was treated this way; however, in a situation that's operational, technicians could look at such kinds of signs and say, "Well, that's expected of the system. Clean it up and let's go on." Development contractors don't do that. Their accountability is to understand in depth what is causing that, why it's different than their certification tests. Certification tests cannot duplicate flight conditions and never will. We are still learning about the tile system. Regardless of who is running the cape, we're going to continue to put our eyes on every one of those tiles on that vehicle to fully understand, as it matures—because there's no way to test that on the ground.

So in my view, we've done the best with our cert programs. I think they have been the best that money could do, and technology could do; they have been pretty damn good. We have found very few areas where we have been surprised. However, it's going to take constant vigilance when we operate in the environments that we operate. It's all the more reason, in my view, for this committee to seriously consider making sure that the development contractors phase out of this thing as its operational maturity evidences itself, and I don't think we have done that properly.

Mr. MURPHY. I think one of the things that is going to prevent a recurrence of what has happened in the past, as far as oversight committees are concerned, is that we have come a long ways since the initial certification of the program. We now have advanced analytical tools which were not available before. We also have the flight environments for the 24 successful flights; it gives us a true indication of what the environment is that we're going to be facing. Plus, again, the environment of the whole aerospace industry has changed dramatically since the 51-L. And all of these, I think, will be taken into consideration and will provide the oversight and the proper review of items that never occurred before.

Mr. NELSON. Congressional inquiry, in and of itself, appears to be critical. And I just want to state at the outset that what we're dealing with here is an incredibly successful flying machine, that you keep hearing these comments about "it's old technology" and folks don't understand that at least three aspects of the STS are incredibly new, radical technology that nobody else has and everybody else wants, including the Soviets and including the intention of the French to build a space shuttle.

So putting my questions in the proper context, I just want to make it clear that we have an extraordinary asset here; and the question is, how do we make it as safe as possible for the future?

All right. Now, I want to end up with this—OK, would the chairman rather me not?

Mr. ROE. No, no. I want you definitely to answer that.

Mr. NELSON. OK. On page 195 of the Rogers Commission report is this quote:

> If Rockwell and Martin Marietta as the development contractor had direct involvement with their elements of the shuttle system, the likelihood of difficulties caused by improper processing would probably be decreased. Furthermore, all shuttle elements would benefit from the advantages of beginning-to-end responsibility vested in individual contractors, each responsible for the design, development, manufacturing, operating, and refurbishment of their respective shuttle elements.

From the Rogers Commission; that was part of the findings, but that was not part of the recommendations. It was part of the findings.

All right. Now, what I want is—since two of the named contractors are represented here, I would like to have your comments upon that finding by the Rogers Commission.

Mr. JEFFS. Well, I fully concur with that finding. We made that point quite clear to the NASA before the SPC was really—when it was originating.

We also looked at ways that we could work with the NASA to reduce the costs of duplication between the development contractors, to attempt to provide the advantages of what the consolidation would bring costwise, along with the advantages of what would be brought by the continual hands-on accountability and association with their hardware. So certainly, I agree with the comment.

That's it.

Mr. DAVIS. In answer to your question, in the written response to your No. 1 question we addressed that directly and stated that, indeed, we felt it was essential that we resume those responsibilities.

Generally, we have been in an oversight/review-type mode that has not allowed us to really know everything that's going on with our hardware; indeed, some of the problems that were outlined in the Commission's report relative to testing that was missed, events that occurred not reported, et cetera, we do not have visibility of that. And it's that lack of visibility that concerns us relative to finally making a commitment, an unequivocal commitment that we're ready for launch.

So in that respect, we fully support those recommendations and we believe it's essential that we get back into that mode.

Mr. NELSON. All right.

Thank you, Mr. Chairman, for this opportunity.

Mr. ROE. I thank the gentleman from Florida.

I want to thank all of our witnesses for an excellent presentation, I think in candor, and it gave you an opportunity to make many of the presentations you wanted to make.

There are a series of other questions, as I mentioned earlier, that we'll be submitting to you in writing, if there's not objection, and we'd like to have you respond to them for the committee. So we will do that further.

Mr. ROE. If there are no further questions, we want to thank you for——

Mr. DAVIS. Mr. Chairman, if you would—with your bearing I'd like to make a very short statement, I believe, to finish up my testimony.

Mr. ROE. Mr. Davis.

Mr. DAVIS. We believe the activities in process to prepare the external tank for launch are thorough and complete. They will help us and the NASA achieve high confidence in the continuing successful operational performance of the external tank.

We at Martin Marietta Corp. are totally committed to making the next and each succeeding shuttle flight a 100-percent mission success, and we are fully prepared to work with your committee to

resolve any issues in the interests of our common goal of returning the space transportation system rapidly and safely to flight status and, in so doing, return our Nation to preeminence in manned space flight.

I appreciate it.

Mr. ROE. Thank you.

If there are no further questions, the committee stands adjourned until tomorrow at 9:30, and we'll reconvene from there.

[Whereupon, at 11:55 a.m., the committee recessed, to reconvene at 9:30 a.m. Wednesday, July 16, 1986.]

INVESTIGATION OF THE CHALLENGER ACCIDENT
(Volume 2)

WEDNESDAY, JULY 16, 1986

House of Representatives,
Committee on Science and Technology,
Washington, DC.

The committee met, pursuant to call, at 9:30 a.m., in room 2318, Rayburn House Office Building, Hon. Robert A. Roe (acting chairman of the committee), presiding.

Mr. Roe. The committee will come to order.

Would the witnesses please rise to be sworn.

We want to welcome you to the session. If you would raise your right hands and repeat after me.

[Witnesses sworn.]

Mr. Roe. This morning marks our second day of inquiry from witnesses that represent the space shuttle's contractors. These 2 days of hearings take us into our fourth week in the series of hearings that the Science and Technology Committee has been holding to investigate the space shuttle *Challenger* accident.

In the design, development, and demonstration of any large-scale program, we must bring together numerous participants in an interlocking and interdependent arrangement to produce a successful program. The manner in which the communications and responsibilities are carried out on a continuing basis in these arrangements determine the progress and operational precision of any program. Each program element has both an individual and an interrelated task.

In the Space Shuttle Program, the various contractors who build and service the shuttle form one such element. The shuttle contractors that we heard from yesterday represented the primary designer/developers of the space shuttle's flight hardware.

Today we will hear testimony from those contractors involved in processing and preparing the various shuttle elements and the associated payloads prior to launch at the Kennedy Space Center.

With us are E.D. Sargent, president of Lockheed Space Operations Co.; Mr. David Owen, executive vice president, Kennedy Space Center; Carver Kennedy, Morton Thiokol, vice president; and Mr. Fred Haise, president of the Grumman Technical Services Division.

We want to welcome you. We are trying to ascertain from all of these representatives how to insure optimum safety in design as well as operation of the Space Shuttle Program. The lessons that we are learning from the January 28 shuttle accident and its sub-

sequent investigations will not only guarantee the future safety of our Space Program, but will also teach us how to avoid these pitfalls in the process of developing future large-scale projects at the national and international level.

We want to welcome you all to the hearing this morning and first and foremost we will now call upon Mr. Douglas Sargent, president of the Lockheed Space Operations Co.

Mr. Sargent.

STATEMENT OF E. DOUGLAS SARGENT, PRESIDENT, LOCKHEED SPACE OPERATIONS CO., AND PROGRAM MANAGER, SHUTTLE PROCESSING CONTRACT, ACCOMPANIED BY FRED HAISE, PRESIDENT, GRUMMAN TECHNICAL SERVICES DIVISION; CARVER KENNEDY, VICE PRESIDENT, MORTON THIOKOL; DAVID OWEN, LOCKHEED SPACE OPERATIONS CO., AND DEPUTY PROGRAM MANAGER, KENNEDY SPACE CENTER

Mr. SARGENT. Thank you, Mr. Chairman and members of the committee.

It is a pleasure to be here today to discuss our task as the shuttle processing contractor, or SPC as it is called. I am here both as president of Lockheed Space Operations Co. and as program manager of the shuttle processing contract.

I hope to provide additional insight into our operating philosophy, and to discuss some specific issues which have been the focus of attention since the *Challenger* accident.

With your concurrence, Mr. Chairman, I would like to submit my testimony for the record and make a few remarks about that testimony. Then I will respond to any questions you might have.

Mr. ROE. Your full statement will appear in the record.

Without objection, so ordered.

Mr. SARGENT. I will briefly describe the shuttle processing contract team which prepares the shuttle for launch at both Kennedy Space Center and, in the future, at the Vandenberg launch site.

Lockheed Space Operations Co. is the prime contractor and is responsible for the administration of the contract and for overall processing oversight. Grumman is responsible for the operation and maintenance of the launch processing system.

Morton Thiokol conducts the major operations involving the external tank and the assembly and retrieval of the solid rocket boosters. Pan American brings their technology to the functions of operations analysis. These four companies form the SPC.

The SPC consolidated some 23 existing NASA prime contracts used for flight hardware processing, ground support equipment operations and related support required to fulfill the space shuttle launch and landing responsibilities.

Some key benefits to NASA are:

To improve safety and mission effectiveness.

Minimize contractor interfaces.

Provide accountability for prelaunch activities; and

Improve efficiency.

SPC acquired in the transition 1,764 Rockwell employees against a requirement for 2,000; 251 Martin Marietta employees against a

requirement for 290, and 100 percent of all other contractor personnel required to fulfill the contract.

In addition, we have major subcontracts with Rocketdyne for shuttle main engine work and with Rockwell for orbiter tile work.

But in a very real sense, the shuttle processing team has many additional players. Our NASA counterparts, of course, provide their expertise and knowledge absolutely vital to the processing task.

Another crucial part of the team is the development contractors—Rockwell for the orbiter, Martin Marietta for the external tank, United Space Booster for SRB's, Morton Thiokol for the SRM's, and Rocketdyne for shuttle main engines.

We work very closely with these development contractors and that interface is most productive. These development contractors are under separate contracts with NASA and as such provide an important check-and-balance aspect to shuttle processing.

NASA development centers issued Launch Support Services Contracts known as LSSC's to the development contractors to hold them responsible for their design from production through processing, launch, orbital, and recovery operations to ensure:

First, onsite focal point for flight hardware design expertise and vendor interfaces and as such a critical check and balance on SPC processing.

Second, interface with design organizations for total definition and approval of vehicle changes;

Third, accounting for the incorporation of the design configuration for each flight.

The LSSC's processing engineering contingent at KSC is currently 103 engineers as compared to SPC's 370 engineers—a ratio of 1 to 3.7.

We also have a very strong working relationship with McDonnell Douglas and EG&G, both of whom are here today.

The SPC team considers our primary mission to be that of providing safe, reliable and efficient processing of the shuttle, a unique spacecraft. This is both a demanding and a challenging assignment and we think we have done well so far.

We believe that we can still make that statement—even after the extensive reviews subsequent to the 51-L accident. We are utilizing the findings of the Rogers Commission as well as other related studies of the Shuttle Program to help us implement broad corrective actions and do our job even better.

We have received some encouragement that we have become an effective team. In its 1985 report, the Aerospace Safety Advisory Panel said that they thought that SPC had laid the organizational groundwork, obtained the right kinds of personnel, and in general, were making satisfactory progress.

The panel also noted that our safety practices and monitoring systems were "praiseworthy." We were especially pleased with this finding since we have stressed safety and quality assurance as our highest priority.

We are also very gratified that the Rogers Commission found that our launch site activities were in general accord with established procedures and were not considered a factor in the accident.

Generally, we think we are on the right track and do not plan fundamental changes in our approach. However, as I mentioned earlier, we are aware that improvements and changes are still required.

Some of the steps we have taken are to further reduce our safety incident rate and to continue that trend.

We were working too much overtime in some specific areas and we must solve that problem before we start launching again. We had implemented some changes to alleviate the problem, but they were not fully effective.

One initiative we implemented which we think has worked very well is our program of "stationizing." In this mode, work crews remain at one station during the shuttle processing flow.

I believe that our shuttle processing work force is outstanding. They are highly skilled, experienced and dedicated to the Shuttle Program. Many of our people have worked on the Space Program for over 25 years. We consider our personnel our prime asset and we place heavy emphasis on developing this resource.

Mr. Chairman, you had expressed an interest in processing changes made to respond to increased launch rates. I would say that we have not implemented any changes to processing operations solely to meet the demands of the increased flight schedule.

We have, however, made several evolutionary changes to improve the efficiency, and thus have helped the rate of overall processing flow. Some of the changes implemented have been automated real time scheduling, stationizing the process, centralizing logistics, and others.

Overall, the process is very complicated and any changes in a system this complex must be approved by NASA and then implemented very carefully to avoid the introduction of new undetected problems.

I anticipate additional improvements including reduction of paperwork and an evolution toward electronic data collection and transcription, addressing an area of concern in the Rogers report.

I hope we can demonstrate in this hearing that the shuttle processing team is well structured to perform its mission and, in fact, has been doing a good job. We have welcomed the assistance of oversight agencies such as the Aerospace Safety Advisory Panel, the Defense Contract Administration Service, and our NASA evaluators. We have been gratified that they have said some very positive things about our performance.

At this time, Mr. Chairman, I would like to introduce some of my associates who are here today. Mr. Dave Owen is my executive vice president and our Kennedy Space Center Launch Site Director. In this latter role, Mr. Owen has direct responsibility for the day-to-day SPC operations at the space center.

Mr. Carver Kennedy, a Morton Thiokol vice president, has been our director of vehicle assembly building and recovery operations. He is presently assigned to the SRM redesign team at Morton Thiokol.

Mr. Shep Cronier is our Pan Am project director.

Mr. Charles Floyd is our SPC systems engineer; Mr. George Peasinger is our business management director; and Mr. Fred Haise, president of the Grumman Technical Service Division, heads

Grumman's SPC effort. You may remember Fred as a former Apollo astronaut who also commanded the very first shuttle flight. He commanded the *Enterprise* flights at Edwards in 1977 and made a total of five landings in all.

Again, we appreciate the opportunity to be here today, Mr. Chairman, and my colleagues and I will try to answer any questions you may have.

Thank you, Mr. Chairman.

[The prepared statement of Mr. Sargent follows:]

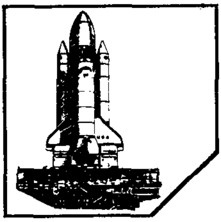
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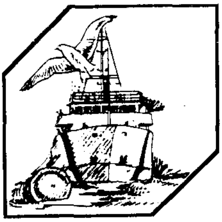
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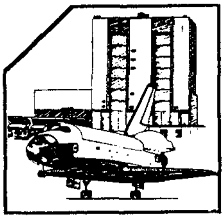
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Presented by Witness
July 16, 1986

Committee on Science and Technology

House of Representatives







Statement by: Mr. E. Douglas Sargent, President
Lockheed Space Operations Company

99th Congress

TABLE OF CONTENTS

TABLE OF CONTENTS, Continued

LIST OF FIGURES

Statement of

Mr. E. Douglas Sargent
President, Lockheed Space Operations Company

before the

Committee on Science and Technology
House of Representatives

Washington, D.C.

July 16, 1986

I. INTRODUCTION

Mr. Chairman and Members of the Committee:

I am Doug Sargent, President of Lockheed Space Operations Company and Shuttle Processing Contract Program Manager. I welcome this opportunity to appear before you to discuss Lockheed's role in the Space Shuttle launch and landing processing at NASA's Kennedy Space Center (KSC). I will describe our responsibilities as the Shuttle Processing Contractor (SPC) and our relationships with NASA and their development contractors. My remarks will be responsive to your request for information relevant to the Challenger accident. In addition, I want to tell you about some adverse occurrences we have experienced and what we are doing to fix those problems. I also want to highlight for you some of our noteworthy achievements.

Finally, I want to tell you how we have responded to the findings of the Rogers' Commission Report. Before I start my statement, I would like to introduce the SPC Team members accompanying me.

II. SHUTTLE PROCESSING CONTRACT ORIENTATION

1. SPC Team Members

Mr. David L. Owen is Lockheed Space Operation Company's Deputy Program Manager and also our KSC Launch Site Director. In the latter role, Mr. Owen is responsible for the day-to-day SPC operations at Kennedy Space Center.

Mr. Carver G. Kennedy is a Morton Thiokol, Inc. Vice President and our Vehicle Assembly Building (VAB) Operations Director. Mr. Kennedy is the Team member responsible for the processing and assembly of the solid rocket boosters and the external tank as well as the retrieval and disassembly of the solid rocket boosters.

Mr. Fred W. Haise is President of Grumman Technical Services Division, our SPC Team member responsible for the operations and maintenance of the Launch Processing System.

Mr. T. S. Cronier is Project Director for our Team member Pan American World Services. They are responsible for providing operations technology and maintenance insight into Shuttle processing.

2. Scope of Work

The SPC scope of work includes all ground processing, launch and landing support of the Space Shuttle vehicles at the Kennedy Space Center and at the Vandenberg Launch and Landing Site (VLS). It also includes support to the United States Air Force in developing and operating the VLS.

3. Operating Philosophy

Our operating philosophy and practices strictly adhere to a set of clearly stated and fully understood principles provided to us by NASA. Among the most critical of these are:

- Safety of personnel and hardware is prime.
- The SPC, NASA and the development contractors perform in an integrated team effort.
- Test and checkout requirements and acceptance criteria are established by NASA and the development contractors.
- All SPC operations are conducted in accordance with detailed, authorized test procedures, work documents and associated paperwork.
- SPC engineering personnel generate and authorize all procedures and documents to implement NASA requirements.
- All critical steps in the test and checkout process and all processing paperwork closure must be verified by quality control inspectors.
- No work is performed without authorizing documents.
- All SPC personnel who perform critical tasks are trained and certified to perform those tasks.
- All ground support equipment and systems utilized in the test and checkout program are calibrated and certified in accordance with appropriate directives.

We believe these principles to be vital to the success of the Shuttle processing task and to be valid and applicable regardless of the launch rate.

III. SHUTTLE PROCESSING

Following a brief description of the Shuttle processing flow, I will address selected topics that have received attention during the recent investigations and which merit elaboration here.

1. The Flow

When the orbiter returns from space, SPC crews resume responsibility for the orbiter at the end of its landing roll wherever it lands, perform safing operations and assist with the exit of the flight crew. At Kennedy Space Center, the orbiter is towed directly into the Orbiter Processing Facility (OPF). At Vandenberg Launch and Landing Site, it will be towed to a similar facility there.

At Kennedy Space Center, post-flight activities are accomplished in the Orbiter Processing Facility. The payload bay is reconfigured, repairs and modifications are made and the orbiter is prepared for its next mission. It is during this processing phase that the orbiter and all its subsystems receive exhaustive testing, required modifications and systems reverification for flight.

From the Orbiter Processing Facility at Kennedy Space Center, the spacecraft is towed to the nearby Vehicle Assembly Building (VAB). In this building, the orbiter is mated to the solid rocket boosters (SRB) and the external tank (ET), which have been previously mated on the mobile launch platform (MLP).

The integrated Shuttle is then ready for transfer to the launch pad.

On the launch pad, final preparations are made for countdown and launch. During final preparation and countdown, loading of propellants, gases and other consumables is completed.

Subsequent to launch, the spent solid rocket booster cases are recovered from the sea and returned to the launch site for disassembly and refurbishment. (Figures 1 and 2 have been included to graphically depict the above general discussion and assist in identifying the SPC areas of responsibility.)

Throughout the flow, the SPC Team works in concert with NASA/KSC, the NASA Development Centers and the development contractors' representatives to form an integrated processing team.

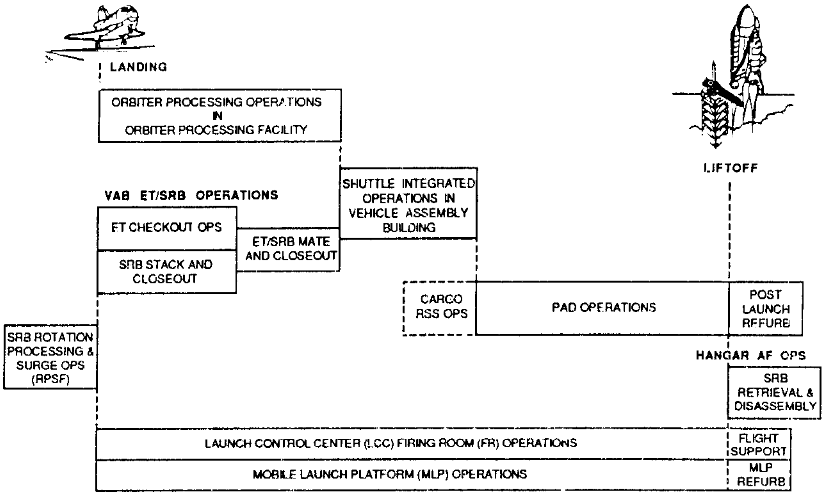


FIGURE 1. SPC SHUTTLE FLOW OPERATIONS AT KSC

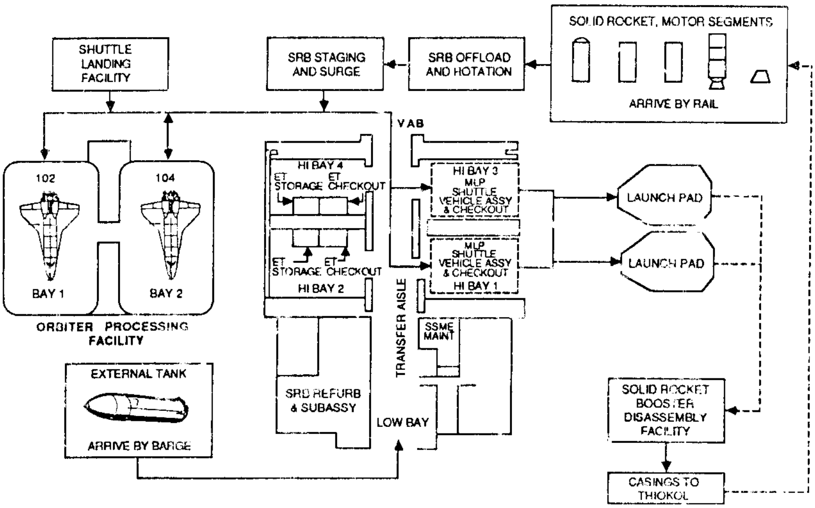


FIGURE 2. SPC PROCESSING LOGIC FLOW

2. Relationships With Development Contractors

As part of the SPC concept, NASA has entered into Launch Support Services Contracts with the contractors who developed the flight hardware to provide continuous on-site technical support services to the SPC. In this capacity they are in the decision-making process for all issues involving their hardware and have complete visibility into the processing activities.

This relationship with the development contractors - Rockwell International for the orbiter; Rocketdyne for the Space Shuttle main engines; Morton Thiokol for the solid rocket motors; United Space Boosters, Inc. for the solid rocket booster hardware; and Martin Marietta for the external tanks provides critical design/manufacturing expertise to the processing of the Space Shuttle vehicle by providing technical oversight and participating in all key and critical steps involved with their hardware during processing. They have authority to stop test operations at any time during processing involving material review, waiver or configuration change actions. Specific Launch Support Service Contractor responsibilities include:

- System Engineering -- provides on-site focal point for flight hardware design expertise and vendor interfaces and functions as a check and balance for processing. All problems of non-blueprint nature, Material Review Board and technical issues require Launch Support Service Contractor formal approval prior to performing any work or moving flight hardware.

- Project Engineering -- provides interface with design organizations for total definition and approval of vehicle changes.

- Configuration Management -- accounting along with the SPC for the incorporation of the designed configuration for each flight, as a mandatory requirement.

- Logistics -- provides on-site focal point for design agency and vendor logistics support.

These close working relationships are illustrated as follows:

Initial operations and maintenance requirements are developed by the NASA design agencies and presented in the Operations and Maintenance Requirements and Specifications Documents (OMRSD). These OMRSDs form the basis for the Operations and Maintenance Instructions generated by the SPC that provide the procedures utilized in processing flight hardware at KSC and VLS. These Operations and Maintenance Instructions are reviewed by the Launch Services Support Contractors, who are local employees of the respective flight hardware development contractors. Launch Services Support Contractor personnel are also involved in disposition of day-to-day test problems, coordination with the home plant for vehicle modifications, and meetings such as Open Item Reviews. The development contractor is represented at all formal reviews.

Verification of the flight vehicle launch configuration is the joint responsibility of the SPC and the development contractors. The vehicle configuration, including pre-launch work performed, is tracked in management

systems created and operated by the development contractors, such as the automated "Configuration Verification Accounting System" or CVAS.

The development contractors also have responsibility for flight hardware sustaining engineering, including the determination and procurement of flight hardware spares.

The working relationships between the SPC and the Launch Services Support Contractors are defined in a series of Memoranda of Understanding signed in February 1984 by the SPC, the particular Launch Services Support Contractor and NASA (KSC and development center representatives).

3. Challenges of Increasing Flight Rates

As flight rates increased, we responded to this challenge and met all our responsibilities in a timely and effective manner. We utilized available resources and established or enhanced procedures to accomplish all requirements. We did not make fundamental changes in our processing operating philosophy as launch rates increased. Specifically, we did not eliminate required testing, inspections or processing steps as we responded to the challenge of increased launch rates. Adjustments we did make were those designed to increase organizational efficiency without jeopardizing the operational philosophy as is further discussed in Section V.

4. Safety and Quality Assurance

Safety and Quality Assurance are primary considerations in all SPC operations. Two key elements are discussed below.

a. Safety Advisory Board

An important element of our overall safety program is the SPC Safety Advisory Board which is made up of nationally recognized experts. Most of the Board members are not members of the SPC organization and, in fact, are not located at Kennedy Space Center. This Board has overview responsibilities for our safety program and practices.

The SPC Safety Advisory Board reviews safety policy and proposed safety standard changes as well as major changes (e.g., test deletions/additions) to the process flow. In addition, significant incident and/or accident findings are studied. Findings are reported to the Lockheed Space Operations Company (LSOC) President and Program Manager, Shuttle Processing Contract.

SPC activities at both the Kennedy Space Center and at Vandenberg Launch and Landing Site are covered during these reviews. Issues or review items that exceed the charter of the SPC are relayed to the NASA Aerospace Safety Advisory Panel for their consideration.

Members of the SPC Safety Advisory Board are:

Edgar M. Cortright - Former President, Lockheed California Company & Director, NASA Langley Research Center

Ray B. Davis	-	Director, SPC Safety, Reliability and Quality Assurance
John H. Enders	-	President, Flight Safety Foundation, Former Technical Assistant to the NASA Administrator and NASA Research Pilot
Fred W. Haise	-	President, Grumman Technical Services Division and Former NASA Apollo and Space Shuttle Astronaut
Willis M. Hawkins	-	Former Senior Vice President, Lockheed Corporation and Chairman, NASA Aerospace Safety Advisory Panel
Lt. Gen. Richard Henry, USAF Ret.	-	Former Commander Space Division and Vice Commander Space Command, USAF
Walt Hurd	-	Former Director Product Assurance, Lockheed Corporation
Owen G. Morris	-	President, Eagle Engineering and Former Manager, Systems Integration, Space Shuttle Program Office, NASA Johnson Space Center
F. S. Nowlan	-	Former Director of Maintenance, United Airlines
William C. Rice	-	Former USAF Commander, USAF Systems Command Laboratory (including Rocket Propulsion Laboratory)

Board meetings are held quarterly, alternating between Kennedy Space Center and Vandenberg Launch and Landing Site. Nine meetings have been held since January 1984. In addition, a number of special studies have been conducted outside the normal meeting forum by one or more members of the Board.

b. Designated Verifier Program

Flight hardware inspections are performed by SPC Quality Control and NASA Inspection personnel only. The Designated Verifier (DV) program is limited to non-critical ground support equipment, systems and facilities.

The Designated Verifier program within our Quality Assurance organization has, in recent months, been the subject of much interest. The Designated Verifier program is a long established element of the NASA KSC Quality Assurance program which has proven over the years to be an effective, efficient means to accomplish selected quality assurance requirements and objectives.

Designated Verifier candidates are selected from the most experienced and capable technicians, receive formal classroom training and are individually approved by the Director of Reliability and Quality Assurance. There are 650

personnel certified to perform as Designated Verifiers. These individuals are authorized to perform quality verification on non-critical and non-flight hardware.

The Designated Verifiers are personnel with recognized experience and ability to perform certain inspections and verifications as defined by the NASA approved Quality Planning Requirements Document for non-flight hardware.

Non-critical operations that a Designated Verifier can verify are individually specified by Quality Engineering in the Work Authorization Document, based on guidelines contained in the NASA approved Quality Planning Requirements Document.

The Designated Verifier program instills an added sense of responsibility and pride of workmanship in the work force and increases quality awareness of the technicians. We have conservatively extended this program as we gained experience.

We are working with NASA to resolve the question raised with this program by the Rogers' Commission.

5. Award Fee

An important measure of SPC performance effectiveness is the Government prepared semi-annual award fee evaluations.

Both the Kennedy Space Center and the Vandenberg Launch and Landing Site portions of the contract have award fee provisions. The Kennedy Space Center portion for the Remaining Basic contract period has a one percent of target cost for an award fee pool and the Vandenberg Launch and Landing Site portion has a ten percent of target cost award fee pool. The Vandenberg Launch and Landing Site portion of the contract has a greater amount of award fee available because it is 100 percent award fee, while the major fee provisions of the Kennedy Space Center portion of the contract is an incentive fee feature, with the incentive fee measuring cost performance and mission success.

The award fee provisions are divided into six equal periods of six months each, with criteria pre-established for each period. This criteria is designed by NASA to identify those areas that the Government wants the contractor to emphasize, or points out areas of concern that require management attention. Safety is always a criterion. The subjective evaluation which the contractor receives for each period is a grade on performance to the established criteria and what corrective action was taken for concerns expressed.

Figure 3 is a summary of the ratings received from the Government for the four periods since contract inception. We have not received our ratings for the fifth period ending March 31, 1986.

PERIOD	ADJECTIVE RATING	NUMERICAL RATING
10/1/83 - 3/31/84	EXCELLENT	90
4/1/84 - 9/30/84	GOOD	78
10/1/84 - 3/31/85	GOOD	76
4/1/85 - 9/30/85	EXCELLENT	91

FIGURE 3. KSC AWARD FEE DETERMINATIONS

The first six month period of the Kennedy Space Center portion of the contract was called "transition." The major criteria during this period were:

1. Accomplish transition from the incumbent contractors in a safe and efficient manner.
2. Provide support to processing.
3. Manage the contract in a cost effective manner, making appropriate cost/performance trades.
4. Minimize incidents involving schedule, equipment damage, employee safety and potential hazards.

Our overall evaluation for this period had an adjective rating of Excellent and a numerical rating of 90.

The criteria for the second period were:

1. Implement LSOC Financial System
2. System Improvements
3. Information Systems Management Plans
4. Security Operations Planning
5. Develop a Management Team Concept
6. Safety

The NASA evaluation for this period had an adjective rating of Good and a numerical rating of 78. A summary of the evaluation indicates that certain criteria were accomplished in an excellent manner (such as Safety), but adequate progress had not been made in others. Our own self evaluation essentially agreed with the Government's evaluation and, therefore, we did not take exception to the rating received, but re-dedicated our efforts to improve our performance.

The criteria for the third award period were:

1. Implement LSOC Financial System
2. Develop a Management Team Concept
3. System Engineering Improvements
4. Develop Shuttle Multi-Flow Processing Capability
5. Develop and Implement Effective OPF Operations
6. Safety

The NASA evaluation for this period was an adjective rating of Good and a numerical rating of 76. A summary of this evaluation indicates that we had met, or were making good progress towards accomplishment of criteria 1 through 4, but criteria 5 and 6 were not met because of an incident in the Orbiter Processing Facility where a payload bay access platform (bucket) fell from its stowed position and struck the orbiter and injured an employee. We feel this incident resulted in at least one lower adjective rating. Again, our own self-evaluation was very close to the Government's and we felt that a lower rating, due to the incident, was appropriate. Therefore, again, we did not take exception to the Government's rating.

The criteria for the fourth award fee period were:

1. Develop a Management Team Concept
2. Develop Shuttle Multi-Flow Processing Capability
3. Develop and Implement Effective OPF Operations
4. Pad B/MLP-3 Activation
5. Develop a Capital Budget
6. Safety

The NASA evaluation for this period was an adjective rating of Excellent and a numerical rating of 91. A summary of the evaluation indicated that the management team had made considerable progress in demonstrating an integrated approach to all aspects of the Shuttle Processing Contract.

The criteria for the fifth award fee period is:

1. Operations Planning and Resource Management
2. Develop a Management Team Concept
3. Develop Shuttle Multi-Flow Processing Capability
4. Logistics
5. Pad B/MLP-3/Centaur Activation
6. Safety

The evaluation for this period has not been received.

IV. ADVERSE OCCURRENCES

While we have achieved a record of solid performance in Shuttle processing, certainly everything has not gone as we would have wished. We have made mistakes and, in some instances, our performance has not measured up to expected standards. In such instances, we have taken immediate remedial or corrective action and we have tried to capitalize on "lessons learned" in each adverse situation. Some examples follow:

1. Orbiter Processing Facility Bridge/Bucket Mishap

On March 8, 1985, during final closeout operations of the Discovery in the Orbiter Processing Facility at the Kennedy Space Center, a payload bay access platform fell from the stowed position and came to rest on the left forward payload bay door. Although the immediate cause of the mishap was mechanical failure of a master link, our investigation pointed out contributory causes that demanded and received our immediate attention. Paramount among these were the maintenance of this equipment, the manner in which tagout/lockout procedures were implemented, and operator training. Our corrective action was:

- o Develop and implement new procedures for the operations and maintenance of the bridge bucket system.
- o Develop and implement a new and more positive safety hazard tag system.
- o Conduct an intensified series of Safety briefings stressing Safety awareness.
- o Retrain and recertify bridge bucket system operators.
- o Complete design review resulting in major redesign to upgrade the safety features of the complete system.

2. 17-Inch Liquid Hydrogen Disconnect Valve Slamming

Another occurrence I want to discuss with you concerns the 17-inch liquid hydrogen disconnect valve. On January 25, 1986, while loading hydrogen propellant for the launch of Challenger (Mission 51-L), the 17-inch disconnect valve was opened in a non-prescribed manner. In fact this highly sensitive valve was "slammed" open rather than slowly moved. Although the valve was not damaged, the potential for serious damage was high. Our investigation into this mishap identified human error and inadequate software lockouts as the cause. The actions we are taking to preclude this happening again consist of:

- o Re-evaluating Firing Room policies, procedures and protocol.
- o Software changes made to preclude inadvertent valve opening.

3. Solid Rocket Motor Segment Lifing Mishap

The final mishap that I will discuss concerns damage to a solid rocket motor during removal of the forward shipping ring. This damage occurred when a load cell on the crane being used for ring removal indicated an erroneous low reading resulting in solid rocket motor damage. Our investigation of this mishap revealed several problems, the most severe being the failure to follow approved procedures.

We took the following corrective actions:

- o Operations & Maintenance Instructions were upgraded.

- Training was reviewed and improved.
- Activities were initiated for crane modification.
- Crane use is restricted until all modifications are complete.

This damaged segment has not flown.

4. Overtime Problem

One problem area which has not been responded to in our corrective actions is excessive overtime. The control of overtime has been a continuing challenge. We have implemented management procedures regulating the usage of overtime, and have installed stringent approval requirements (all overtime requires at least a director's approval). To date, none of these attempts have been completely effective. Compounding this issue, particularly in the Orbiter Processing Facility, is the degree of unscheduled, out-of-station work imposed by orbiter modifications and "cannibilization" caused by lack of spares. With time, these factors will improve to significantly alleviate overtime requirements. When we have to chose between impacting the manifest or increasing overtime, we have usually chosen the latter.

Frankly, we still don't have a viable solution to this problem. However, we can assure you that we are working this problem and we must and will find an acceptable solution.

In brief, we acknowledge that we have had problems. In fact, we would not want to lead you to believe the above is a complete list; however in each instance, we have taken prompt effective corrective action and we learn from each adverse occurrence.

V. SPC ACHIEVEMENTS

The SPC Team has achieved a great deal in terms of fine tuning existing systems, applying sound effective management techniques in accomplishment of the processing task. We have made substantial progress in the very critical and demanding task of preparing a vehicle for safe reliable launch, flight and landing. We present in this section representative examples of these initiatives.

1. Transition

The first major challenge successfully met by the SPC was to maintain continuity in the technical work force while implementing a new management approach. We were able to capture over 90% of the incumbent work force we had targeted in our hiring plans. Successful transition of the incumbents was a key criterion for the first award fee period and our achievement was recognized by a Government rating of "Excellent" for the period. In fact, NASA personnel expressed a degree of surprise at the high capture rate and smoothness of transition. We were able to hire a sufficient number of the right people to continue to perform the processing tasks and accomplished a primary goal of a nondisruptive transition into the SPC era.

2. Consolidation of Support Functions

The consolidation of support functions into single organizations is a direct product of the SPC concept. This results in improved communications, increased organizational efficiencies and lower costs through better usage of the work force and substantial reduction in overhead costs. Functional organizations that were consolidated include Logistics, Safety, Reliability, Quality Assurance, Finance, Human Resources, and Program Controls.

3. Stationizing

"Stationizing" selected segments of the work force is an operational method consistent with increased flow rates and does not represent a fundamental change in processing procedure or philosophy. Basically, stationizing means moving from a flow management to a facility management concept, where the vehicle moves from station to station and the work force remains fixed at each major facility, or "stationized."

As a result of stationizing the work force, personnel became better skilled in accomplishing routine as well as non-routine tasks, and processing time was reduced as personnel, parts and paper no longer moved with the vehicle, but were pre-positioned and ready to support scheduled activities. As a result of more experience within their area of responsibility, they become more familiar with what was a "normal" and an "abnormal" situation encountered during the processing of flight hardware and can react accordingly. Stationizing also permits us to collect and process data on a common base for trend analysis.

4. Streamlining

The SPC has instituted a number of enhancements which streamline processing. Among such actions are:

a. In the Orbiter Processing Facility we stationized Work Authorization Documents, improved organization communication, placed increased reliance on automated scheduling, increased efficiency of logistics support and improved ground support equipment maintenance.

b. Our Process Planning and Control organization initiatives included improvements in Work Authorization Document processing, computer aided planning and control, computer aided ground support equipment availability and automated shop schedules. This group also developed the KSC/VLS Commonality Plan.

c. Our Launch Processing System Software group achieved improvements in time/cycle tracking, universal Firing Room console loads, the facility modification tracking system, Launch Pad A/Launch Pad B Compatibility Link, and flow to flow vehicle/facility/ground support change tracking. This group has developed significant enhancements in simulated power application/removal, the Kennedy Avionics Test Set, satellite transfer of flight software between Johnson Space Center and Kennedy Space Center and the Electrical Connector Analysis Network.

d. A number of additional "streamlining" initiatives are planned in the Orbiter Processing Facility, the Process Planning and Control organization and in Launch Processing System software.

5. Personnel Development and Training

We have revised and improved our technical training and certification and our management development programs to insure career opportunity as well as the availability of properly certified personnel. Further, we have improved our ability to incorporate training record data for use by Quality Control and other SPC management groups. All personnel were honored for their achievements when NASA/KSC selected Lockheed Space Operations Company for its "Large Contractor of the Year" Award for 1985 for its support to small business.

6. Work Force Morale

We have an experienced, highly skilled, and very dedicated work force. We have employed a number of effective programs to insure that work force morale remains high in spite of launch aborts, high overtime rates, and more recently program uncertainty, in the aftermath of the 51-L tragedy. We utilize comprehensive employee communication media, suggestion programs, supervisor meetings, human development programs and "family" outings to insure that our people are informed about the program and are aware that management is concerned about their well-being. We think these efforts have a positive effect. Our employees are highly motivated and team-oriented and not just in terms of work performance. We usually have excellent turn-outs for such things as our Savings Bond drives, over 93% of our people invest in bonds, blood donor campaigns and the United Way. They are involved in community programs. We are very much a people-oriented company and generally I think our people realize this. We work hard to have a two-way communication with our work force and I am always pleased to get feedback from them. Steve Godfrey from our Process Engineering section recently sent me an informal note in which he said "I have been pleasantly surprised with the fairness, professional handling of difficult situations and the obvious feeling which Lockheed top management such as yourself has for the work force. I have been in the business for a long time and have seen a lot of contractors come and go, but I am most impressed with the Lockheed people." Feedback like this makes us think we are on the right track. I should note that I also get some reports which are not so positive and I respond to those as well.

Finally, all out efforts were made to insure that as many employees as possible could take time off during major holidays.

7. Accident Prevention

Although we have experienced some mishaps that have been very disappointing to us (previously addressed in Section IV), we are not deterred from our ultimate objective of zero incidents and mishaps on this program.

Recognizing that accident prevention is the best way to protect the program, NASA property and our employees, we have established an aggressive Safety Awareness program which includes:

- Safety orientation (all employees) first day, thirty days later, and every six months
- Safety notices, bulletins, newspaper articles
- Daily work briefings
- A Safety "Action Line" for safety calls
- Safety checklists - areas and jobs
- Safety committees
- Employee Safety Handbooks
- Personal involvement by employees

A review of the numbers of reportable mishaps related to launches (see Figure 4) indicates that we are improving our Safety performance on the program. NASA has concurred with this position and has presented the SPC with the NASA "Award of Distinction" for "Outstanding Achievement in the Field of Accident Prevention," for our 1984 record, and again for our 1985 record.

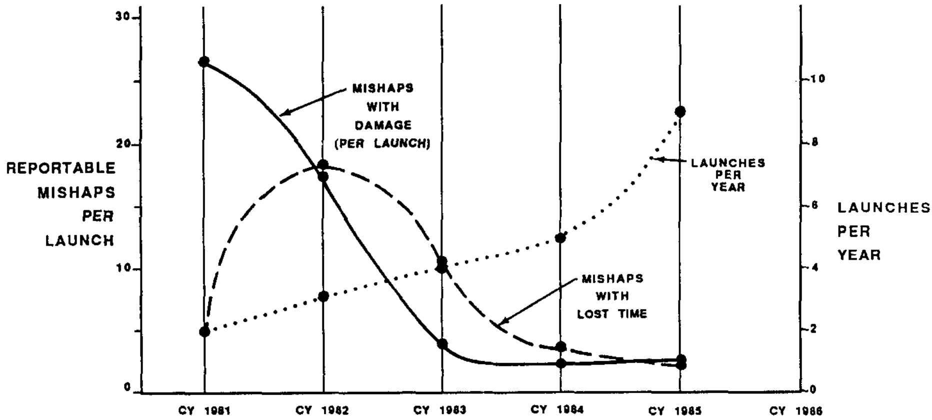


FIGURE 4. REPORTABLE MISHAP TREND DATA FOR KSC

These data reflect a favorable trend; however, any mishap or incident is unacceptable. Our efforts to reduce these occurrences have to be continuous. We know we have a lot of work ahead of us in order to be successful. We are pressing hard in our effort to drive our rate as close to zero as possible. The Incident/Error Review Board is a significant element in our plan for accomplishment.

8. Incident/Error Review Board (IERB)

This organization (Board) was established to insure that strong positive action was implemented in response to unplanned incidents. It is chaired by the SPC Director of Safety, Reliability and Quality Assurance, and is composed of the first line Directors involved in processing and support operations. Every incident and error, including "near misses" where no damage or injury occurs, is reviewed in detail by this Board in session. Investigations are assigned. Reports are studied. Corrective action is planned, assigned and implemented. The Board tracks progress of the corrective action, and when complete, orders a "third party" evaluation to assure the elimination of hazards and condition correction prior to formal closure. The Board meets on a weekly basis. The results of this Board meeting are presented weekly (including any new incident), to the SPC senior management at the Program Integration Board meeting.

9. Achievement Summary

We believe the foregoing initiatives demonstrate a pattern of innovative and effective management actions to improve the Shuttle processing activities. Both NASA and USAF have expressed approval and confidence in our SPC approach. Further, similar expressions of confidence have been forthcoming from a number of knowledgeable independent sources.

The Aerospace Safety Advisory Panel in its reports for 1985 found that,

"The Shuttle Processing Contractor, while not yet at its peak, has laid the organizational groundwork and obtained the right sort of people. A general assessment indicates satisfactory progress is being made. Launch rate predictions are still optimistic. Arrangements for transfer of functions such as sustaining engineering, logistics management, etc., from JSC to KSC seem to be well organized and orderly, if somewhat slow. Overall safety practices and monitoring systems -- especially by the SPC -- at KSC are praiseworthy and would appear to do everything reasonable to ensure the safety of operating personnel."

Additional accolades came from the Defense Contract Administration Services Region following their review of the SPC procurement system. They formally approved our system and noted our procurement people were knowledgeable, enthusiastic and had outstanding documentation to support their procurement actions.

We are appreciative of these kinds of observations and are continually working to improve so that we will be worthy of similar comments in the future.

VI. PRESIDENTIAL COMMISSION REPORT FINDINGS RESPONSE

Immediately following the Mission 51-L accident, the SPC participated with NASA in salvage and recovery operations, several investigations and continuing studies and planning. In addition, action was taken to examine the processing of flight hardware at Kennedy Space Center and particularly the

paper systems which controlled and monitored Mission 51-L processing. Although our internal findings corroborate those of the Rogers' Commission, that "Launch site activities ... were not considered a factor in the accident," we also agree that comprehensive review of our paper system, increased attention to training and discipline regarding the use of those processing systems is warranted and is being implemented.

1. Commission Findings

The following sections address those Commission findings related to the processing and assembly of the elements of Mission 51-L.

a. Missed Requirements

The Mission 51-L audit review of the Operations and Maintenance Requirements and Specifications Document compliance revealed six areas where such requirements were not met and not formally waived or excepted. These were:

- A formal post-flight inspection of the forward external tank attach plate was not documented (this plate was removed after Mission 61-A and a new plate used for Mission 51-L).

- A forward avionics bay closeout panel not verified as installed during rollover/stacking operations (the area was properly configured prior to flight with installation of a locker).

- Only one of two crew hatch micro-switches showed closed. (Condition was documented by a Problem Report and was deferred.)

- Post-flight hydraulic reservoir sample not taken prior to connection of ground hydraulic support equipment at Dryden Flight Research Facility. (It was performed later in the Orbiter Processing Facility at Kennedy Space Center.)

- Auxiliary power unit pressure not maintained above 20 inches of mercury for five minutes as required. (It was maintained at 19.8 inches for 2 hours because equipment could not hold pressure at 20 inches and was documented as acceptable by NASA.)

- Landing gear voids not replenished and crew module meter not verified during final vehicle closeouts. Landing gear voids were replenished during launch countdown.

These were investigated and determined to be caused by human error. The corrective action is to provide additional training for compliance with Standard Practice Instructions and to clarify and simplify the paper system to make it more useful to the worker.

b. Accidental Damage Reporting

During interviews, the Commission identified a serious problem that indicated technicians were fearful of losing their jobs if they reported causing unintentional damage to the Space Shuttle System.

Lockheed has always subscribed to the policy of forgiveness. However, there have been specific circumstances where disciplinary action was appropriate and has been taken. The SPC policy is to insure that all employees (including supervision) understand that failure to comply with processing instructions or good safe work practices is unsatisfactory; however, the approach is one that encourages an errant employee to voluntarily report it so that proper steps in the process can be initiated. On April 30, 1986, a survey was conducted to determine the employees willingness to report a mistake that caused damage. Eighty supervisors and 607 technicians responded to this survey and 99 percent of the supervisors and 96 percent of the technicians stated they would report without fear of discipline. The SPC has initiated a special program to insure that all employees are aware of the forgiveness policy.

c. Involvement of Development Contractors

Another example of the need for enforcing rigorous anomaly reporting was discussed under INVOLVEMENT OF DEVELOPMENT CONTRACTORS (the development contractors' responsibility and relationship to the SPC is discussed in Section III of this document). During external tank propellant loading the liquid hydrogen 17-inch disconnect valve was opened at an incorrect manifold pressure causing the valve to slam open abruptly. The cause was human error and inadequate software design which permitted the event to occur. The action taken was the issue of an Engineering Bulletin to alert all personnel of this incident; the formation of a special committee to address Firing Room policies, procedures and Firing Room protocol; and, finally, the initiation of software redesign to preclude this event from recurring.

d. OMRSD Violations

In Appendix C, the Commission cited nine examples of Operations and Maintenance Requirements and Specifications Document (OMRSD) violations. Changes have been requested in the OMRSD for three of these because they were impossible to perform due to access problems. Two of these violations were human error which resulted in disciplinary action and refresher training. The other four items were due to errors in the Operations and Maintenance Instructions. These Operations and Maintenance Instructions are being corrected.

e. Orbiter Processing Paper

Also in Appendix C, the Commission commented upon representative samples of orbiter processing paper deficiencies. These included 121 Operations and Maintenance Instructions, 479 Work Authorization Documents and the paperwork associated with 22 Modification Change Requests. They cited large percentages of paper errors and anomalies. The SPC acknowledges these deficiencies in the paperwork, agrees that the rate of deficiencies is unacceptable and is working to fill the need for a simplified and "user-friendly" system.

f. Structural Inspections

The structural inspection program for the orbiters is being fully implemented on the required life cycle schedule. The three orbiters will have complete inspections as required before flight.

g. Designated Verifiers

The policy of using Designated Verifiers to supplement the quality assurance force has proven successful. This subject was discussed in detail previously in this document. We are carefully reviewing the Designated Verifier program with NASA to insure that it does not introduce weaknesses into the Safety and Quality Assurance program.

h. Launch Pad 39B

During the launch of Mission 51-L, Launch Pad 39B sustained the least amount of launch damage of any Shuttle flight. Three areas of minor damage occurred:

- Loss of springs/plungers on hold-down posts
- Failure of gaseous hydrogen vent arm to latch
- Loss of brick from flame trench.

Facility fixes for these three items are scheduled for work before the next use of Launch Pad 39B.

2. Paperwork Project

The Space Transportation System paperwork processing system was cited in the Presidential Commission Report as cumbersome and labor intensive. We agree and have a goal of improving the work control system and evolving the paperwork to a more simplified and user friendly tool. A paperwork improvement project was formally initiated in November 1984. Tasks have been added and modified ever since and there are now thirty-three tasks under this project. Ten tasks are complete and three are on hold, the remainder are active and statused at a weekly Progress Review. All tasks are scheduled for completion by January 1987.

In addition, a number of changes have been implemented to improve the way process paper is managed and to strengthen Quality Assurance activities. Among them are: Documentation Review, Documentation Training and OK-to-Process.

a. Documentation Review

A Documentation Review system is in place. A specialized group of inspection personnel was selected and trained to audit processing documentation for accuracy, adequacy and completeness.

64-548 O—86——4

Following work completion by Operations and acceptance by SPC Quality Control, all completed documentation is reviewed at the work station by a member of the Documentation Review group. Each page or sheet is stamped to reflect satisfactory completion of the documentation. Any problems are referred to appropriate supervision for correction on-the-spot.

Documentation is not processed out of the work station until it has passed this review.

b. Documentation Training

To assure correctness and completeness in the documentation of processing operations, classroom and on-the-job training as being conducted by the SPC Training organization and Quality Control.

These classes emphasize the importance of all documentation and the requirement for documentation with zero defects. All technicians, inspectors, engineers, planning personnel and related supervision involved in the processing activity have received, or are scheduled to receive, this instruction.

c. "OK-To-Process"

A system is being installed in the processing flow to provide improved incremental visibility, management and control. This system provides for incremental points of acceptance by SPC Safety and Quality Assurance for continued processing.

At specific points in the processing flow, Safety and Quality Assurance verify that all safety requirements have been satisfied and that all work and technical requirements have been satisfactorily completed. Any exceptions require resolution at the director level with concurrence by the Directors of Safety and Quality Assurance.

Specific checklists and job instructions are being prepared for each verification point in the process. Verification by Safety and Quality Control is included as a specific entry in the processing documentation. The requirement for these verifications will be included as specific events in the KSC Integrated Control Schedule.

The processing flow requirements (pre-planned work), real time or added requirements, and related documentation, will be organized to support these incremental reviews. This system provides for incremental acceptance of the flight vehicle and clearance of the documentation.

The final verification by SPC Safety and Quality Control is an "OK-to-Launch," issued immediately prior to the initiation of the Launch Countdown.

3. Skill Training and Certification

While the above efforts are focused mainly upon our paperwork and quality control systems we also are actively improving the whole work force's skill level with a comprehensive training program.

There are a total of 261 classroom training courses being given to SPC personnel. Twenty-three new courses have been developed this year. They cover systems, skills, safety, and paper processing. In the on-the-job-training area, we have planned the development of 350 training packages with 167 complete, 66 in work, and the rest are planned.

A Master Training Meeting is held weekly, chaired by the Director of Operations, and attended by all operating department directors and NASA. Since February 1986, a total of 2,304 personnel have been certified or recertified by meeting an exacting set of criteria. On the average, each of these certifiable people receives four different certifications to be qualified in their work area. More than 12 classes are offered each day, covering all three shifts. All personnel are scheduled to complete required new courses by the end of 1986.

4. Response Summary

We are in total agreement with the theme of the Rogers' Commission Report - "Make Future Flights Safer." Our full resources will be focused upon the achievement of this essential requirement. Lockheed and the SPC Team members have completed a thorough examination of the Rogers' Commission Report. We believe we understand the issues behind the report's recommendations and the corrective actions which need to be accomplished.

VII. SUMMARY

In summary, the SPC concept is well-conceived and functioning as intended as an integrated element of the Space Transportation System team effort, an effort which involves NASA, U. S. Air Force, Development Contractors, Payload Contractors, Base Support Contractors, and the SPC.

The SPC has performed less than perfectly at times, and we have experienced some significant mishaps. However, we have benefitted from the lessons learned in each case.

We maintain an exemplary safety record particularly in view of the potential hazardous exposures inherent in the program.

We produce a high quality product in launch and support processing and have met all mission objectives for which the SPC is responsible.

Our quality programs continue to be improved.

We have incorporated many operational enhancements to increase efficiency and effectiveness and to support increased launch rates. Many more enhancements continue to evolve.

The SPC is responding with vigor to the task of assisting in the investigations and corrective actions since the Mission 51-L accident.

In this regard, we are gratified that no SPC actions or operations were identified as contributing to the cause of the Mission 51-L accident.

We acknowledge the Presidential Commission Report items attributable to the SPC and provide our assurance that all are being addressed. We will benefit from the lessons learned.

And finally, we appreciate the opportunity to testify before this Committee and pledge our full cooperation in attaining your objectives.

Thank you. We are prepared to answer questions at this time.

Mr. ROE. I want to thank the distinguished gentleman for his presentation.

Is there anybody else on your team that wants to comment at this point or shall we go right to questions?

Mr. SARGENT. No, sir.

Mr. ROE. Welcome again to the hearing. I think your testimony has summarized pretty well what you have submitted in your detailed report. There were a number of interesting items in the structural relationship, in the Chair's judgment, of your organizational program and contractual agreements you have with NASA we felt.

The second point that is important, the basic area on page 2 that spoke to operating philosophy, was an important list of items that you spoke to, because I think that is part of where we are at this stage of the hearing.

In other words, we are getting more in depth into the management area as you are aware and that will be the direction the questioning will take today.

I would like to specifically ask the first question. Yesterday in our testimony with the hardware contractors, the developers, they were unanimous in their observations that they felt that they were not effectively used as an integral part of your team basically is what they were saying and I note that in your full testimony and your summary that you say, well, there is very great, good coordination between the two.

So immediately, and I don't mean my opening remarks to be one of determination or decisionmaking, but I think it would be profitable for you to express, in view of their testimony yesterday, your observations of that. They seem to feel that they have lost part of the communications flow, they have lost part of the control in effect of their own proprietary equipment for—which they think is affecting its efficient use, its placement into the assemblage and so forth. They felt there was a breakdown there.

Can you talk to that a bit?

Mr. SARGENT. Yes, sir. I heard some of that testimony yesterday. First, I was a little confused because I thought Mr. Murphy was saying that the system worked very well initially.

Mr. ROE. We were a little confused, too, because they were saying that they felt the cooperation with NASA was excellent, that they had the right to speak, if anything—if they were concerned about something as far as a launch would be concerned, they felt they could reach the top, so it was a little bit ambiguous.

Mr. SARGENT. There is a very close relationship between the development contractors, the LSSC's, one of those for every four of our engineers. There are participants on all meetings on processing and further than that they are required to authorize and approve anything that is off the regular documented trail, in other words, anything that doesn't fit. They are in the middle of any changes to be incorporated and there are certain critical points they review.

During the processing of the SRM, there is a LSS engineer assigned to that and I remember specifically that he was required to agree that the O-ring was installed properly, that the leak plug was installed and was properly torqued, as an example, and he is required to sign off and indicate that that operation has been done

properly. So they are an integral part of our operation even on the routine. Any new design or any deviation from the routine, they are even more heavily involved.

So not only are they involved, they need to be. We depend on them very heavily to help us do our job, so it is a true team effort.

Mr. ROE. Well, apparently we have a definite conflict here. Here we have three of the major corporations who testified yesterday as developers. They feel that there is a breakdown in their ability to get the effective feeling that their equipment is being properly handled so they feel they can speak to that in the systems approach that you are talking about.

You are saying we don't think that is really so because we have their engineers and there are different checkpoints along the line where they are involved.

I also note on page 2 that you speak to the numbers of people that you inherited under that contract from Rockwell and from Martin Marietta and also from Rocketdyne. So when you say inherited, what happened. They came on your payroll then?

I am trying to put this together. Something is wrong someplace. Where is it wrong? You don't agree. They don't agree. What are the facts?

Mr. SARGENT. When the SPC was formed——

Mr. ROE. Why was it formed?

Mr. SARGENT. To combine 23 primary organizations into 1 so there would be complete accountability for who was doing the launch processing.

Mr. ROE. What was the problem before that?

Mr. SARGENT. With the responsibility broken into so many parts, 23 primes and over 100 subcontractors, it would be difficult to tell who was responsible for what.

Mr. ROE. Were they all reporting directly to NASA? This plethora of subcontractors and contractors were reporting to some structure in NASA at the time?

Mr. SARGENT. Maybe Fred Haise can help me. He was there.

Mr. HAISE. Yes, sir.

In that period, NASA was really acting as the integrator across all that contractor forum at Kennedy Space Center.

Mr. ROE. Let me try again. Where I am coming from, I am trying to build into the record why we are spending a billion dollars on a contract to coordinate the program and what effectiveness is it? Should it be considered? Because I think that contract is coming up for consideration in October, therefore, there was a reason to establish a coordinated umbrella approach.

Before NASA decided to make that move, as you are both pointing out there, there was a plethora of contractors reporting to NASA per se who in effect was the coordinator of all the subcontractors at that point.

Is that reasonable to say?

Mr. SARGENT. Yes, sir.

[The information follows:]

WHY DO WE HAVE THE SPC?

Insert following line 362:

Efficiency of SPC: The SPC concept is highly efficient and achieves the following important Shuttle program goals:

- Establishes SPC contractor accountability for ground processing of flight hardware and consolidates the efforts of 23 previous contractors.
- Accomplishes the vast amount of engineering, technical, and "hands on" work effort necessary to prepare Shuttles for the rigors of space flight. It's one billion well spent.
- Provides for high visibility of SPC team activities and establishes a critical check and balance between the hardware suppliers and the SPC team.
- Reduces costs by eliminating duplicate administrative effort and achieving operational efficiencies by standardizing systems and procedures.
- Establishes the organizational and management framework necessary to meet future launch rates required by the U.S. Government space program.
- Reduces the number of interfaces between contractors and between the Government and its contractors.
- Increases contractor flexibility to allocate manpower resources to meet operational demands.
- Provides a stable, responsive and uniform framework for the incorporation of program and processing changes expected to come out of the current reviews.
- Provides the most experienced Shuttle processing team available. Has processed more Shuttles than any other combination of contractors.
- Has established and stabilized the engineering and technical work force by eliminating the trauma of periodic contract changeovers and numerous contractors.
- Establishes and maintains the maximum potential commonality between the Kennedy and Vandenberg launch sites.

The SPC has clear accountability to NASA and provides the only means for the Government to cost effectively implement the anticipated changes to the Shuttle processing procedures without further de-stabilizing the vital work force at Kennedy Space Center. Given the uncertain future and direction of the Shuttle program, the work force does not need the additional trauma associated with a reversion to the multiple contract situation which preceded and precipitated the creation of SPC. We anticipate that many of

our best people would seek less volatile opportunities elsewhere if they lost their SPC jobs and were required to seek employment with development contractors, develop new working relationships, understand another company's ways of doing business and process orbiters for launch. The SPC is the optimum processing concept -- viable, effective and cost efficient.

Impacts if the SPC concept was abandoned would include:

- Loss of the system of checks and balances between the processor and developer.
- No single point of accountability for landing to launch Shuttle processing
- Loss of commonality of operations, administration, and management between KSC and VLS Shuttle processing.
- Destabilize the engineering and technical work force again.
- Increase cost and proliferation of interfaces.

<u>Development contractor visibility and accountability</u>: All development contractors currently have vital roles in the Shuttle program which include meaningful visibility into processing operations. For example, they are currently under Launch Support Services Contracts (LSSC) with NASA which give them wide visibility into processing work effort and hold them accountable for their design and production of flight hardware through processing, launch, orbit and recovery operations.

The LSSCs are further supported by joint NASA/contractor Memoranda of Understanding (MOUs), developed as part of the SPC implementation plan. The MOUs define responsibilities, interfaces and working relationships between the SPC and the LSSCs and are signed by both contractors as well as the NASA development and launch processing centers. They specify functional and procedural responsibilities and provide for close interaces and lines of communication. In the operating environment at the floor level, both the formal and informal disposition and feedback on problem resolution are working well.

The MOUs ensure precise definition of authority and accountability and attain the optimum system of checks and balances inherent in the development contractor/LSSC/SPC structure.

The MOU for the Rockwell LSSC covering the orbiter and orbiter ground support equipment (GSE), for example, specifies that Rockwell will:

- Concur in the disposition of engineering changes, Material Review Board actions, unexplained anomalies, and Operations and Maintenance Requirement Specification waivers;
- Provide design change coordination and expertise;
- Provide assessment of safety impact of SPC proposed operational changes, and review mishap reports, proposed corrective actions and proposed safety waivers;
- Support all critical vehicle tests with technical personnel;
- Have access to all processing data and reports and all Problem Reports and failure analyses;
- Review pedigree and advise on acceptability of proposed cannibalizations; and,

- Coordinate with SPC and resolve differences surfaced during Flight Readiness Reviews.

A Flight Readiness Review (FRR) is a serial process of assessing the readiness of the flight hardware prior to committing to launch. All contractors and appropriate NASA centers participate in FRRs.

The final formal review occurs about ten days prior to launch. This review is chaired by the KSC Center Director and attended by other NASA organizational directors, development center representatives, development contractor representatives and the Shuttle processing contractor. The final agenda is a poll of all representatives to provide them the opportunity to voice any concerns, disagreements and/or give their approval to proceed with the schedule and launch as planned.

Should there be any concerns, these are assigned to the proper people for resolutions before proceeding beyond an agreed to point in the processing/launch cycle.

The extensive involvement of the development contractors was very well described by their representatives in testimony before this Committee on July 15, 1986. For example, testimony showed that one development LSSC team uses their highly qualified and experienced managers to:

- Become aware of anomalies beginning with manufacturing, and monitor and track anomalies which occur after the transfer of hardware to the SPC Team.

- Maintain involvement in all phases of assembly and test by the SPC team including countdown, launch operations, recovery and disassembly.

- Conduct postflight inspection and continuing assessment of flight hardware condition.

- Maintain a Problem Report System to identify and track all anomalies and develop trend data to assure corrective action.

- Report all functional failures and anomalies to the Flight Readiness Review Board.

Other testimony establishes that the development contractors have a:

- Strong voice in a launch decision which, if necessary, can stop a launch.
- Requirement to stand up and unequivocally commit their hardware to a go or no-go decision.
- Significant presence in the Firing Rooms.
- Great amount of real time visibility into the problems.

The SPC has the highest regard for the particular knowledge and skills of development contractor employees. We work closely with them and we believe there is an excellent working relationship between the SPC team and the manufacturers of the flight hardware. Given the national significance of the task before us, we hope this relationship will continue and even improve.

Mr. ROE. Therefore, somebody made a command decision that in order to get a smoother flow, I assume, of information, interchange of information, somebody had to coordinate this monster from a business management point of view. Is that reasonable to say—an engineering point of view?

Mr. SARGENT. I would say it is broader than that. The SPC assumed the functions and the people to the actual task being performed, and the coordination feature was part of the SPC formation. It eliminated—for instance, early on, each prime contractor had their own spares and their own logistics. This allowed us to combine that into one stockroom where 1 storekeeper could handle the spare parts for all 23 contractors.

So it is much broader than just the coordination function. The coordination function falls out of it as a result of having one organization doing the whole thing.

Mr. ROE. So what we are saying is that to improve the efficiency and the operation and logistic flow of the materials and so forth, the SPC contract was decided to coordinate that all in one group; is that correct?

Mr. SARGENT. To perform it all under one company; yes, sir.

Mr. ROE. Therefore, it is under one contract so you are responsible to do that under the basic contract; right?

Mr. SARGENT. Yes.

Mr. ROE. The next point that comes out, and I agree that in the response in the Rogers report they had nothing deleterious to say about that operation; in fact, they said it worked, but I am concerned as we are getting into the management of this whole organization, going into reorganization by Dr. Fletcher, should we continue with the SPC contract? It is a billion-dollar contract.

Tell me why we should continue that when we have a difference of opinion that has arisen where the proprietary contractors of the hardware do not feel they are an integral part of the system.

Mr. SARGENT. There are two parts to the question. By combining the billion-dollar contract, it was a good deal less than it would have been with individuals. I think if you were to revert back to the other one, the cost would be greater. The other is I strongly believe that accountability is a big part of the game and clearly with one contractor responsible for the prelaunch preparing, checking out and processing of the flight hardware, in my mind there is no question about the responsibility for that function.

I believe there was none before.

Mr. ROE. The interesting point, and I will stop at this point, is that the contractors that were speaking yesterday, the different executives, also talked about accountability and they felt that there was a glitch someplace in their judgment on accountability between the responsibility of the SPC group, the team as it related to the effectiveness of their being able to guarantee and feel totally safe with the proprietary equipment.

That is generally what they said.

Mr. SARGENT. Yes, sir. May I respond to that?

Mr. ROE. Yes.

Mr. SARGENT. I believe the key to that, the accountability by the development contractors and that is certainly essential, is the

LSSC team. There are engineers on site at Kennedy participating in the processing of the flight hardware.

Mr. ROE. I thank the gentleman.

The Chair defers to the distinguished minority leader from New Mexico, Mr. Lujan.

Mr. LUJAN. Thank you, Mr. Chairman.

Following up on that, the processing contract, does it include like the retrieval of the solid rocket booster when it falls into the ocean and inspecting and repairing it?

Mr. SARGENT. Yes, sir. Morton Thiokol is responsible for the retrieval itself. Maybe Morton Thiokol would like to comment.

Mr. LUJAN. Under subcontract to Lockheed or under their own contract?

Mr. SARGENT. No. Under subcontract to the SPC, under subcontract to Lockheed, the literal retrieval. There are additional steps after retrieval, after the solid rocket booster is returned to port where it is turned over to another contract and another responsibility.

We are only responsible for literally the ships that go out and retrieve the SRB casing.

Mr. LUJAN. Once it is retrieved, who inspects it then?

Mr. KENNEDY. The SPC contract and the subcontract to Morton Thiokol is responsible for retrieval of the SRB's and bringing them to dry land. There is an engineering inspection team from the development contract side of Morton Thiokol, which is separate from my responsibilities, that comes from the home plant. They do the inspection. I think you are alluding to the O-rings.

Mr. LUJAN. Using that as an example of all the things, how it is done.

Mr. KENNEDY. The engineering team from the development contractor organization does that inspection and writes the final reports on the performance, et cetera. That is not only true for Morton Thiokol. There is a similar team from the United Space Booster Organization which inspects their hardware, which is also retrieved as part of the SRB, the skirts, the hydazine power supplies, which are their responsibility.

They have a development contractor team that comes in and inspects their parts also.

Mr. LUJAN. The same holds true for the engines? Lockheed doesn't do the inspection; you have a subcontractor?

Mr. SARGENT. We have a subcontractor, Rocketdyne.

Mr. LUJAN. With the developer to check him out?

Mr. SARGENT. We have a subcontract with Rocketdyne who is the development contractor, but they also subcontract to us for all shuttle main engine work.

Mr. LUJAN. They have a subcontract to you—what I am getting at is I understood yesterday, and I think that is where the chairman was moving, that the development contractors felt that the thing was getting away from them, like maybe Morton Thiokol, they weren't here yesterday, but if we are going to use the solid rocket booster as an example, that it was not totally in their control and that they were expected to certify that it was working—let me not use Morton Thiokol because they weren't here, but Rocketdyne, for example, Rockwell was here—that they are expected to

certify that that engine and all of the different parts are in tiptop condition and ready to go.

They don't really have full control of it. Is that correct? That is what I gathered yesterday from the developers that they used to under the old way, but under this way they don't.

Mr. SARGENT. I understand and it is a fairly confusing scenario, but Rocketdyne has two roles.

They were the development contractor for the shuttle main engines. They also have a separate contract to us on the shuttle processing contract to do the processing work for the shuttle main engines. It is two separate efforts though similar to what Mr. Kennedy described.

Mr. LUJAN. I understand that and under the processing part of it, under the processing contract portion, is the concern here. Do they have physical control and all authority all the way from the day that that shuttle lands out at Edwards until it gets back on the pad? Do they have the control of it so that they can or are able to certify that it is flyable?

Mr. SARGENT. They have the complete control as far as the shuttle main engines, including the refurbishment and checking out and verification for reflight.

Mr. LUJAN. So it is really no different than it was before as far as their concern, having had a separate contract? They now don't have a separate contract with NASA, but they have the subcontract from Lockheed and they do exactly the same as they did before?

Mr. SARGENT. Sir, I would classify it that way. Essentially they have the same responsibilities. In addition, they have, I believe, five or six of their LSS engineers which are on the old contract that also oversee it.

Mr. LUJAN. It strikes me as kind of funny then that it would be less expensive and that is not the big point, but that everybody is doing the same thing they were doing and now they have an umbrella over it and now it is less.

It sounds like we lose money on it, but make it up in volume.

Mr. SARGENT. It is a combination of having separate areas and warehouses and being able to combine it and realize efficiencies from that mainly, sir.

Mr. LUJAN. Thank you.

Mr. ROE. The Chair recognizes the gentleman from Missouri, Mr. Volkmer.

Mr. VOLKMER. Thank you, Mr. Chairman.

I would like to get into the question that we read quite a bit about in the Rogers Commission report with regard to overtime and its possible effect on safety.

If I remember right, you had quite a bit of overtime back in January; is that correct?

Mr. SARGENT. Yes, sir. Some of the areas were running quite high overtime, yes, sir.

Mr. VOLKMER. And what have you all done since then in making studies or whatever to alleviate this problem in the future?

Mr. SARGENT. Well, we have—I wouldn't want to tell you, sir, that we have completely solved it. We have worked the problem. We have tried some things before that. We went on what we called

odd work weeks where different people had different days off to spread the load. We escalated the level of approval required for working excessive overtime.

Mr. Owen had to personally approve anyone that worked 7 days and, of course, the situation presently, we are not working high overtime because we are not flying. I wouldn't want to tell you we have completely solved it, but we do have some ideas in mind.

One of the problems that bothers us and drives us to overtime is either unplanned work or another form of unplanned work which is a hold or abort on the pad where we have critical skills that are required to perform functions.

Mr. VOLKMER. In reading your full statement, I find in here that cannibalization was a causation of a lot of overtime?

Mr. SARGENT. Yes, sir, cannibalization also contributed because it contributed to the overall workload.

Mr. VOLKMER. What about moving, 61-C being delayed and running it into January and knowing that you were going to have to go with 51-L right away? What about that?

Mr. SARGENT. Yes, sir, that contributed to overtime. Any unplanned work or events in that category would drive up overtime.

Mr. VOLKMER. Was this amount of overtime that occurred in January reported to NASA, either on site or at headquarters?

Mr. SARGENT. Yes, on site they were aware of the overtime we were working. Yes, sir.

Mr. VOLKMER. Were they aware of the problems it was causing?

Mr. SARGENT. I think they were generally aware of the difficulty we were having; Yes, sir.

Mr. VOLKMER. Now, how is the overtime figured into the contract with NASA? The processing contract. Is that a cost-plus or is that your cost or what?

Mr. SARGENT. That is a sharing—we are on a cost-incentive program.

Mr. VOLKMER. I know you are.

Mr. SARGENT. The overtime we assumed for the original contract I believe to be at 5 percent—the 5-percent level.

Mr. VOLKMER. Overtime at 5 percent?

Mr. SARGENT. Yes, sir.

Mr. VOLKMER. That is an allowance?

Mr. SARGENT. That is what we based the contract on; Yes, sir.

Mr. VOLKMER. But overrunning up to 25 percent in January?

Mr. SARGENT. Yes, sir.

Mr. VOLKMER. Mr. Chairman, I have some serious problems because we are getting into possibly in the spring of 1988 hopefully we are going to see the shuttle fly again and we know at that time we are probably only going to have three and so the problem shouldn't arise.

If this problem—do you agree with that, that the problem should not arise?

Mr. SARGENT. Yes, sir.

Mr. VOLKMER. With only three shuttles?

Mr. SARGENT. Well, we need to resolve the overtime problem before we fly again.

Mr. VOLKMER. What are you actually doing then to alleviate this overtime problem to identify how you can correct it and come in

here and say, "Now we have got the solution. We are not going to have it in the future?"

Mr. SARGENT. Let me ask Mr. Owen to answer that. He has been working on this problem for us.

Mr. OWEN. We have recognized and realized in our future planning that the space center is going to have to operate 7 days a week, three shifts a day. We have formulated our plans and are currently giving NASA our plans as to how to man the space center at that level and I am going to use the odd work shift approach, odd work week approach to this to eliminate the overtime. That is our plan.

Mr. ROE. Would the gentleman yield?

Could you give us for the record—we are talking about different percentages and I understand fairly well the substance of your contractual arrangements. What in dollars was the overtime? For example, can you give us some idea as to figures?

Mr. OWEN. I went back and calculated it and the overtime for the 51-L, 61-C and I think I looked at 45 on STS 33. It runs about a million dollars each launch.

Mr. ROE. About $1 million each launch.

The gentleman from Missouri.

Mr. VOLKMER. I would like to carry on with another question with regard to this. Since you are on the incentive fee and award basis contract, does the overtime, the amount of overtime over and above the 5-percent impact adversely on that determination as to the amount of the incentive fee?

Mr. SARGENT. Yes, sir. It does.

Mr. OWEN. Yes, sir.

Mr. VOLKMER. So you would like to stay away from the overtime as much as possible.

Mr. SARGENT. Absolutely.

Mr. VOLKMER. Your answer to me was that you are going to be able to use different types of hours and shifts, et cetera, to get away from this overtime.

Does this mean also additional employees?

Mr. OWEN. Yes, sir. We figure roughly in the critical processing areas about an increase of 20 percent in employees in our engineering organizations and technician organizations.

Mr. VOLKMER. With that you are coming up for a renewal in September on the contract; is that corrrect?

Mr. OWEN. Yes, sir.

Mr. VOLKMER. Does that mean that you are going to be proposing to NASA an increase in that contract because of that 20 percent increase?

Mr. OWEN. Yes, sir.

Mr. VOLKMER. How much are we talking about as far as the increased proposal, or is that proprietary?

Mr. OWEN. No, sir. It is not proprietary at the time. I don't have the figure because we are just in the formulation of what those costs are going to be, but it should almost balance off what we have been spending in overtime.

Mr. VOLKMER. You will agree with the Rogers Commission's findings, et cetera, that overtime does impact adversely on the safety of the operations?

Mr. OWEN. Yes. We have a very serious concern about that and we have since day 1, absolutely. We think that it is more critical in some areas than others. A lot of the people that work overtime are there and on station for the expertise that they have. They are not necessarily physically performing, this type thing, because it has always been the history of the Manned Space Program to have, when you are in critical areas of launch, that you do have that expertise standing by in case there is a requirement to that. But in certain areas when people are actually doing physical labor or manning consoles, we have a great concern about that.

Mr. VOLKMER. To get back to the question of your incentive fee and award and overtime effect on it, quite a few of the changes made and the cannibalization made is caused by NASA, is that correct?

Mr. OWEN. Yes; it is caused by the program, that is correct, administration of the program.

Mr. VOLKMER. Do they take that into account when they determine the amount of overtime that will be allowed or not?

Mr. OWEN. Yes. There is some type of an adjustment, but normally we have a cost performance factor and we are required by contract to make the schedule commitment that is laid before us.

There is a change incentive in the contract. Where we have identified such things as additional landings at Dryden and so on and so forth would put us over the threshold of where the change point was, then NASA had added that to our contract; yes.

Mr. VOLKMER. Can you give me—and I am sure that if you don't have it, but I think you would have it, but if you don't, say so—the additional costs that were incurred as a result of cannibalization from 61-C—in other words, prior to its being used—and then also 51-L and the costs of replacing those items, or is that too difficult?

I don't want to spend a lot of money getting this information if it is not readily available.

Mr. OWEN. Sir, we can certainly give you the list of items and what we think would have been the time involved in removing and replacement of that item, but everything that takes place, it would be hard to really identify what the actual cost of that would be.

Mr. VOLKMER. You got the cost of removing the item. You got the cost of putting back another item in there.

Mr. OWEN. Yes, and it also depends on where in the process you were when you had to make this replacement as to how much retesting you would have to do because of that.

It also has an impact of where you took the item from, how much retesting you have to do when you replace that item. There is so much of it it would be difficult to give you an accurate cost of that. We could certainly make an attempt to do it, but the accuracy of it would be in question.

Mr. VOLKMER. Let me ask you right now, how many of the shuttles, the three remaining, are cannibalized right now, have parts that are missing?

Mr. OWEN. I would say offhand that all three of them have some parts missing.

[The information follows:]

CANNIBALIZATION

Insert following line 718:

BACKGROUND

There were several questions during the July 16, 1986 hearings of the House of Representatives Committee on Science and Technology that required a follow-up response on: 1) cannibalizations, 2) criticality items, 3) missing parts from remaining vehicles, and 4) the SPC FY 1987 spares budget estimate. Throughout, the subject of cannibalization of parts for the orbiters has been an issue. Therefore, the genesis of cannibalization warrants a brief review.

Early in the program, decisions were made that have resulted in there being insufficient spare parts to maintain the orbiter fleet in an operational configuration. As reported by NASA to the Roger's Commission, "...intentional decisions were made to defer the heavy build-up of spare parts procurements in the program so that funds could be devoted to other more pressing activities." "...our parts availability is well behind the flight need...". Therefore, the practice of parts cannibalization has been used to meet flight schedule demands even though recognized as undesirable and an action of last resort. There is not a positive means to guarantee the total elimination of cannibalization and to approach that goal is extremely costly. The objective is to reduce the number of cannibalization actions by maximizing the use of existing parts inventories, reducing repair turnaround time, increasing an inventory of miscellaneous small parts, and assigning priorities to the long lead items.

The following broad definitions were used in preparing this response:

Cannibalization

The orbiter parts and materials required to support the processing tasks are issued from existing inventories within the SPC or delivered from Rockwell if they have not been transferred to the SPC inventory. There are certain parts that are not available from any source in time to meet processing schedule need dates. These items may be obtained by means of removing them from another orbiter to satisfy the more critical requirement of the orbiter in the processing flow.

Criticality Code

The code that identifies those systems or components which, if they failed, could present a risk to the safety of the crew or could result in loss of the vehicle or mission. Items cannibalized were checked against the Critical Items List (CIL) and, if included in the CIL, identified on the listings provided (Ref: Orbiter Vehicle Operational Configuration Critical Items List, STS 82-0039A, Books 1, 2, 3 and 4, November 1, 1982). As a result of a Commission recommendation, the CIL and associated analyses are undergoing a reassessment and re-evaluation. The

results of this NASA lead effort are not expected before the Fall of 1986.

1 Loss of life or vehicle.

1R Failure of redundant hardware elements could cause loss of life or vehicle.

2 Loss of mission.

2R Failure of redundant hardware elements could cause loss of mission.

3 All others.

Missing Parts

The number of specific parts that have been removed from a vehicle which have not been replaced with serviceable parts.

TYPICAL CANNIBALIZATION SCENARIO

1. Line Replacement Unit (LRU) has been found to be defective.

2. SPC Logistics is contacted to see if a spare is available on site and to obtain an estimated delivery date (EDD).

3. Assuming no spare is available, utilizing the EDD (if available), Operations Management and Flow Processing Management determine if rescheduling can avert the need to cannibalize.

4. If rescheduling or deferring the affected processing functions cannot be absorbed without serious schedule impact, the LSSC is requested to indicate which orbiters have acceptable like replacement parts installed.

5. Concurrence to cannibalize is obtained from the SPC Director of KSC Operations and the responsible NASA Flow Director.

6. The SPC Systems Engineer writes a Test Preparation Sheet (TPS) to cannibalize the LRU from an Orbiter of lower priority.

7. The Systems Engineer obtains approval signatures from:

   Engineering Supervisor, SPC
   Logistics Manager, SPC
   Systems Engineer, SPC
   Bay Manager, Orbiter Processing Facility (OPF)
   Project Engineer, NASA
   Quality Engineering, SPC
   Flow Director, NASA

- Upon LRU removal, the TPS is routed to Logistics so that a Parts and Material Request (PMR) is written to order a spare LRU for the cannibalized Orbiter.
- The cannibalized part must be reinstalled and reverified/retested when available.
- This process results in unplanned wear and tear of the part and the risk of additional damage to the LRU due to the added removal and replacement.
- In the course of the above scenario, disruption to this and/or processing flows may be significant.

CANNIBALIZATION COSTS

- Impact to Processing of Orbiter with Failed Line Replacement Unit (LRU)
  - Cannibalization is always the last resort because of inherent hardware risks and cost/schedule impact. A cannibalization decision is preceded by a detailed review of status of LRUs in the repair cycle, research of configuration/interchangeability and negotiations with NASA, all of which consume valuable schedule time. As a result, the removal of the failed LRU and the cannibalized LRU are not always in parallel which impacts the schedule of the Orbiter with the failed LRU. The cost impact of these delays vary. The cost signficantly increases as you progress through the processing span.
- Impact to Processing of Orbiter Selected for Cannibalization
  - The Orbiter selected for cannibalization is based upon LRU interchangeability and minimum cost/schedule impact. Because of the small fleet size and length of the processing cycle, cannibalization generally occurs after the Orbiter has started its processing cycle. The processing cycle is initially impacted by the removal of the LRU and the attendent disruption to planned activities. The primary impact, resulting from a shortage of parts on the vehicle being processed, is a rescheduling of the effort which usually must be worked on overtime in order to maintain launch schedule. The "as run" data was analyzed for STS-11 through STS-33 to assess the impact of cannibalization on processing cycles. This data is summarized in Table I. This table shows that parts installed on the Orbiter which were removed from other Orbiters. The impact in shifts reflect the disruption caused in the scheduling of the Orbiter from which the parts were removed. The average for 16 flights is 28 shifts, of which approximately 20% is recovered through workarounds. Therefore, there is an average of 21 shifts of work which must be recovered in the schedule. Based upon three shifts a day, seven days of schedule must be recovered. This recovery is usually accomplished by working overtime. Our studies indicate that it costs approximately $64,000 in overtime to recover a day lost in the Orbiter Processing Facility. Based upon an

average of seven days lost per flow, this would equate to approximately $450,000 of added overtime cost per flow. This does not take into consideration the additional hidden cost associated with the disruption that is caused.

TABLE I

CANNIBALIZATION SUMMARY

MISSION	STS NO.	ORBITER	CANNIBALIZED PARTS INSTALLED	IMPACT IN SHIFTS TO CANNIBALIZED VEHICLE
41B	STS-11	(099)	11	47
41C	STS-13	(099)	8	51
41D	STS-14	(103)	39	79
41G	STS-17	(099)	12	41
51A	STS-19	(103)	8	3
51C	STS-20	(103)	14	6
51D	STS-23	(103)	3	0
51B	STS-24	(099)	20	68
51G	STS-25	(103)	19	23
51F	STS-26	(099)	9	0
51I	STS-27	(103)	7	3
51J	STS-28	(104)	22	15
61A	STS-30	(099)	14	0
61B	STS-31	(104)	9	10
61C	STS-32	(102)	85	55
51L	STS-33	(099)	45	49
		AVERAGE	21	28*

* Approximately 20% of the impact in shifts can be recovered by workarounds.

Mr. VOLKMER. Thank you, Mr. Chairman.

Mr. ROE. I thank the gentleman.

The Chair recognizes the distinguished representative from California, Mr. Brown.

Mr. BROWN. Thank you, Mr. Chairman.

It seems to me you have a tremendously complex organization here and I have great difficulty understanding it, which isn't necessarily bad.

Tell me—you have sort of an organization that was formed by cannibalization, in effect. You pulled people from various different organizations, put them together into what ostensibly is a more effective organization, is that right?

Mr. SARGENT. Yes, sir.

Mr. BROWN. Is there some, and I presume that there is—some understanding that in the event you don't get the contract renewed that the people have some sort of rights to return to their other organizations, some sort of tenure that they would continue in the program but in a different capacity?

Mr. SARGENT. No, sir; there is no agreement like that, at least not to my knowledge.

Fred, you were involved in the formative stages. I am not aware of any.

Mr. HAISE. No. I might relate to that, that that has kind of been the history at Kennedy.

If you go back to the startup of the shuttle, many of the people that gravitated to the element contractors, you would find one or two other companies preceding that the local hires as the current, then element contractors staffed up.

And a number of transitions such as that have happened at the cape where people have moved from company to company.

Clearly, to allow the railroad train to continue on any of these episodes you really have to capture and recruit a fairly large number of those people in place who are trained and certified to do that job, and that is the way you carry forward the corporate memory.

It is really a change of the management organization and, say, the top two levels of management that are in place to perform the job.

Mr. BROWN. Do these top two or three levels of management—don't they have some basic security with the companies from which they originally came?

Mr. HAISE. That would depend, again, on the company and their requirements at that time, whether they could stay local or not or would be forced to move.

Mr. BROWN. Well, there is no particular point in it. I am just trying to understand how a complex organization like this forms and then after it is no longer needed what happens to it.

What kind of a mechanism do you have for maintaining, we will say, optimum management procedures in a company like this?

Do you have an organization and management staff that tries to unify all these diverse elements into an effective working organization?

Mr. SARGENT. Yes, sir, we do. We have a common documentation system, for instance, that we call SPI's, standard practice instruc-

tions, which apply to the entire team and give common practice and procedures for how we will operate.

By the way, it also includes Vandenberg, the organization out there.

Mr. BROWN. We have before us some information to help us with this hearing process, and there is reference to an accident which occurred in November 1985 in which a crane was used improperly to remove a handling ring from a solid rocket booster as—segment as it was being unpacked from shipping. I am sure you are all familiar with that.

And according to this, there was—among the reasons for this was the safety responsibility delegated but not clearly understood by the technicians, inadequate pretask briefing, ground crew not observing the lift, and quality control not monitoring the work.

Now, I am not even certain that all of these are accurate, but in the event they were accurate, how does your management structure respond to this in order to ensure the nonrepetition of these sort of things; in other words, continuing to enhance the quality process, the quality improvement process of performing this work?

Mr. SARGENT. Sir, perhaps we can answer that in two parts.

I would like to address what we have done in regards to the system and then Mr. Kennedy can talk about specifically that problem, perhaps.

We initiated a safety awareness program. As a matter of fact, next week the second iteration of that will be going on where every single employee is gathered and we have talked to and emphasized safety and the need to pay attention to procedures.

We initiated a more intensive training program for the areas where we thought we were deficient. We have beefed up our certification program and took several systems type steps to emphasize that.

By the way, the words that you are using—I will probably shoot myself in the foot with this—but those were our words. We went and checked to review the situation, and we review ourselves very critically. We found some instances of all of those in that isolated area, and we felt it called for very positive and prompt action.

Mr. BROWN. I don't think you should feel you are shooting yourself in the foot by having properly identified a problem and taking corrective action to correct it.

That is what I would expect and that is the reason for my questioning as to what mechanism you have for doing that.

Mr. SARGENT. If you read our audit reports, you will find we are critical with ourselves and interested in flushing out the shortcomings.

Mr. BROWN. I don't think we need to have Mr. Kennedy explain what you are doing. I am interested in the overall process.

It seems like a commonsense objection that you get a better work force performance when they have a clearly identified sense of being; that is, they feel that they belong to an organization which they understand, which is one reason I want to understand what your organization is, and that there is a clear delegation of responsibility for corrective action in all of these kinds of situations.

One of your problems, I suspect, in maintaining the enthusiasm, commitment, and loyalty of employees, is providing this sense of

identity within an organization, and, of course, clearly delineating responsibilities.

And you feel that despite the complexity of this, which I don't pretend to understand, that you are able to achieve this?

Mr. SARGENT. Yes, we do.

In this particular case, it was within the Morton Thiokol organization. There was a corporate identity.

Mr. KENNEDY. I would like to respond.

In any incident that occurs in the SPC contract performance, the first action is that there is an incident investigation team formed. That is one independent to any of the people that are involved in the incident itself.

That committee—the operation is stopped, nothing is allowed to proceed, all the records are impounded—and that committee conducts an investigation, presents their findings, and then the corrective actions in response to those findings have to be put in place before that operation can continue. And that is true whether it is this incident or any other incident we have on the base.

In this particular incident—to give you an idea that the kind of thing you are worried about, how do you get a team effort—this particular incident involved personnel from both Morton Thiokol and Lockheed.

The plans were prepared by Lockheed personnel. So, there is a standard applied across the board to all personnel in the SPC, not just to the individual companies.

We use the SPC standards, and the SPC investigates, not Morton Thiokol. I believe that a great effort has been made by SPC to build that team feeling.

If you were to walk out during operations in my area, which is the Vehicle Assembly Building, it would be difficult to tell without walking up and examining the name on the badge who worked for Lockheed, Grumman, or Morton Thiokol, because we work as a team.

We have an integrated operation. Certain functions are performed by each company. They meet together and work together as a team, and I believe that that has been a major challenge in the SPC of bringing 23 contractors, diverse personnel, together and doing that, and I believe that has been done very well.

I think that team now thinks as a team, and I think they are now in business.

We apply the same disciplinary rules across the board. By definition we have agreed to the same benefits packages.

For instance, if a Morton Thiokol employee has some particular skill that Lockheed feels they need, that person can transfer, with both sides agreeing, and maintaining his benefits just as if he continued to work for the same company.

We started the SPC, and it has come out to be a successful, integrated team activity. Those people now think as SPC and not as 23 separate contractor employees, at least in my opinion, in my area.

I cannot speak across the board, but in my area, I believe those people would tell you, yes, they feel they are managed fairly and evenhandedly, and the same criteria is applied to everybody and the same rules have to be followed by everybody.

Mr. BROWN. I appreciate your assurance on that and have no basis for disagreeing with you, but this is such a unique management effort that it would seem to me that we would benefit or those who are interested in management as a science would benefit from your historical analysis of your successes and failures with this.

One of you ought to write a paper about it.

Mr. KENNEDY. I think I will let Mr. Sargent. I am a little busy right now.

Mr. BROWN. Thank you.

Mr. ROE. The Chair recognizes the distinguished gentleman from Florida, Mr. Nelson.

Mr. NELSON. Good morning.

I would like to follow up on what I hear over and over, and I hear it from you all. I hear it from the grassroots level, not only at Kennedy but throughout the system.

And that is the question of the spare parts. Now, Mr. Volkmer has talked about that today, and I just want to give you the opportunity of an open forum here to put for the record how important spare parts are, and if you can, put a dollar figure on the overall dollar figure needed for spare parts for the existing three orbiters, looking to the fiscal year 1987 budget. That would be a welcome piece of information, as well.

Mr. SARGENT. Well, sir, there is no question that the spare part shortage is a key element. Maybe one of the unfortunate things is it is not immediately apparent.

You solve the problem by going over and robbing from another vehicle. Meanwhile, you may hold up the flow. You may be working things out of sequence. You are exposing the vehicle you are removing the part from, to potential damage.

Under the best of conditions you have to reinstall the replacement part eventually where you took it from, test that and verify that, so it doubles up work.

I am telling you things that are obvious to you.

Mr. NELSON. Let me stop you right there, Mr. Sargent. What you have said, I think, is a key for understanding the efficiency of shuttle processing and the cost-effectiveness.

Going and cannibalizing a spare part from another orbiter, bringing it over, the testing that has to be done to verify that and then when you take another spare part and put it on the one that has been cannibalized, you have to go through all the testing procedures there.

Have you got a percentage figure ball park of what might be the increased cost as a result of having to cannibalize a part, bring it over and put a part back on the orbiter you have just cannibalized?

Mr. SARGENT. I think we have taken cuts at that. We don't have a good handle on it. We are working on that because it has a direct impact on us.

I am sorry. I guess we don't have a number that we could provide.

Mr. OWEN. Just too many variables in it.

Mr. SARGENT. It also has the subtle impact of us working out-of-station which drives up the cost; also, just doing things that were unplanned.

As a matter of fact, it even has an impact on overtime.

Mr. NELSON. Overtime, things that you didn't plan and working out-of-station?

Mr. SARGENT. We don't like to do things different if we can avoid it. We like to do them sequentially and as planned. We don't like to deviate from the plan if we can avoid it, because that introduces uncertainty also and going to cannibalization often causes you to do exactly that, work out-of-station or different than you would plan to work.

Mr. NELSON. I had interrupted you there to underscore that point. Please go ahead.

Mr. SARGENT. The cannibalization—I think I was just about through—has been a major impact to us, and it has been almost invisible. It is not the sort of thing you see.

As long as you could solve it and go to another vehicle and get that component, it was not obvious other than to us who had to do it.

Mr. NELSON. In the last two flights, 61-C and 51-L, did a good bit of cannibalization go ahead in the preparation of those two flights?

Mr. SARGENT. Yes, it did. I don't know how to quantify it. Dave, can you quantify the amount?

Mr. OWEN. Yes, and I think if you would allow me, George, do you have the statistics on that? We can quote for you.

Mr. NELSON. While he is coming up, Mr. Sargent, I want you to be thinking about if you have a dollar figure you want to recommend for overall spare parts to be provided in the fiscal year 1987 budget.

Mr. SARGENT. I don't have it with me, but I would be glad to work on that with NASA.

Mr. NELSON. I want it directly from you, not through NASA.

[The information follows:]

SPARES COST

° Premise

The orbiter spare parts budget must be structured to ensure spares support the number of missions scheduled. The number of vehicles, the number of units of the same part number in each vehicle, the predicted failure rate for that unit, and planned flight rate are all data elements used in the spares predictions analysis. Lockheed has performed several independent analyses (which have been provided to NASA KSC Logistics) that assessed spares levels of selected, high cost parts, including items which have experienced cannibalization action during SPC orbiter processing.

° Budget Estimate

Based on a fleet of three orbiters, a projected build-up to twelve missions per year starting with four flights in 1988, Lockheed's estimate for the FY 1987 budget for orbiter spares to support processing is approximately $150 million.

NOTE: This estimate does not include related logistics costs of repair, repair parts or any other design center requirements that have been submitted by other contractors and NASA, and represents only the spares portion of an approximately $260 million orbiter logistics budget required in FY 1987.

ATTACHMENT B-1

Mr. SARGENT. I will do my best. I am not sure I have access to dollar numbers for components. I am not sure I have any visability to the dollar number. I think I can take a good cut at what the types and level of spares should be and perhaps can get to a dollar number.

Mr. NELSON. If you could give a percentage figure on what might be the increased cost as a result of cannibalization—are we talking about a 10-percent increase, a 5-percent increase in cost and so forth.

This is going to be important to us as we look to the future trying to solve this problem.

Mr. Owen.

Mr. OWEN. Yes, sir. The data is on the STS-32. We had 73 cannibalizations during that process.

Mr. NELSON. Which one was STS-32? What was the mission number?

Mr. OWEN. STS-32 was 61-C.

On 51-L we had 25 cannibalizations.

Mr. NELSON. And how much was on 61-C?

Mr. OWEN. Seventy-three.

Mr. NELSON. OK. Seventy-three on 61-C, which was the January 12 flight, and on 51-L you said 25 parts were cannibalized?

Mr. OWEN. Yes, sir.

Mr. NELSON. I had information that 45 of 300 required parts were cannibalized, which is about 15 percent.

Mr. OWEN. Well, we had a requirement of 42—is that correct, George?

Mr. NELSON. Well, it doesn't make any difference. The fact is that it is a sizeable slowdown, a sizeable extra amount of work. Whether it was 25 parts or 45 parts, it is sizeable.

Mr. OWEN. The disparity in the numbers, Mr. Nelson, is my quotations were LRU's. The cannibalization of LRU's and their report to all the hardware across-the-board.

Mr. NELSON. I thought I understood all the acronyms, but I don't know what LRU's are.

Mr. SARGENT. Line replacement unit.

Mr. NELSON. Looking at 51-L, was there anything in the process of the cannibalization of those parts, anything that was unusual, particularly stressful?

Share with us any of your information.

Mr. SARGENT. As related to cannibalization? No, sir.

Mr. NELSON. How about 61-L?

Mr. SARGENT. I don't recall anything that would cause a stressful situation because of that. We always have had trouble, as you probably know, in our close-outs of the aft section because of the engine components, pump replacements, those type things, and we spend a lot of time and effort back there when we get into that situation.

We have a tendency to spend a lot of time back there and are very careful when we close that out. Probably there are some cases of it around, but I don't know what they are.

Mr. NELSON. OK.

Mr. Chairman, we will be following up in our subcommittee, which is a very important part about the future effectiveness, cost efficiency, and ability to operate in the system so that they don't

have to constantly worry about making mistakes and so forth because they have gone back, had to retest something because they have cannibalized.

Let me end with one further question.

When we get back to flying again, Dr. Fletcher has said—although he hasn't said definitively—but he is talking about within a few years that we are going to be at the rate of 12 flights a year.

And the question is, you gave us some new information here today where you said that you are going to be recommending to NASA three shifts, 24 hours a day, 7 days a week.

Is the current work force going to be adequate? Are the current procedures going to be adequate or are we going to see significant changes there?

Mr. SARGENT. I think that the current procedures are adequate to do this. We will have to add to the work force, of course, to do it.

As far as the stability of the program, it will definitely require more management attention than we had before, so actually, the cost of management will increase.

It doesn't necessarily provide the most efficient way that you would perform this type of operation, because at certain points in time, due to schedule, you have got more work than you can actually cover with the numbers of people, but when you get one in orbit and another on the launch pad, in that sequence it becomes an intricate schedule of training and certification and these type things that have to take place, so we will be a much busier center around the clock.

Mr. SARGENT. It will be a selective three shift. In fact, I don't believe Morton Thiokol would have to work three shifts.

If I could get back to the spare parts for a second, I should have mentioned that the SPC is not responsible for the spare parts funding or identification.

We, nevertheless, will take that action laid on us.

Mr. NELSON. The reason I asked you is that you are the one who is directly affected by the lack thereof.

Mr. SARGENT. I agree entirely, and I am delighted to respond to that.

Mr. NELSON. Thank you, Mr. Chairman.

Mr. ROE. The Chair recognizes the distinguished gentleman from California, Mr. Packard.

Mr. PACKARD. Thank you, Mr. Chairman.

The entire discussion this morning on several aspects weaves together, I think, a deep concern that came out rather clearly in our hearings 2 or 3 weeks ago, and they all seem to be interrelated—the cannibalization problem that extends into the overtime problem, but there were other overtime problems inherent within itself, and the problems that that was creating on the—on personnel.

Let me ask—first of all, on the cannibalization, it appears to me that if our cars and other pieces of equipment are standard procedure, any time you have a factory-installed piece of equipment it generally operates better and is generally perceived to be safer and better, and when we continually move or do field replacements, it tends to open up the possibilities greater for safety factors, and that is of deep concern.

Were any of the cannibalized items in flights 61-C and 51-L—were those critical items? How did they list on the criticality list?
[The information follows:]

61-C AND 51-L CANNIBALIZATIONS

Items Removed and Replaced Through Cannibalization on 51-L (STS-33/OV-099)

The following list reflects that during the processing cycle of 51-L for the January 28, 1986 launch, there were 25 cannibalization actions (parts removed from another orbiter). There were several items that had multiple cannibalizations; such as heavy weight heatshields which had three cannibalizations. (Note: The reason for this is there were only two full sets of this configuration of the space shuttle main engine (SSME) heatshield within the program at that time.) Therefore, there are only 16 unique parts listed on the attached chart with the number of cannibalizations for the listed part identified under QTY (quantity) column. Of the 16 unique parts, one was identified as Criticality 1 and two as Criticality 1R.

NOMENCLATURE	PART NUMBER	CRITICALITY	QTY
FUEL CELL	MC464-0115-3001	1R	01
PAYLOAD DATA INTERLEAVE	MC476-0136-0004	*	01
ORBITER MANEUVERING SYSTEM CONTROLLER	MC621-0009-0125	*	01
NOSE LANDING GEAR TIRE	MC194-0007-0002	1	02
PURGE SYSTEM TUBE FITTING	MD273-0025-1006	*	04
PREFORMED SEAL	MD273-0026-0006	*	04
CONNECTOR	ME273-0125-0004	*	01
PURGE SYSTEM TUBE FITTING	ME273-0127-0004	*	01
LIQUID LEVEL SENSOR	SV766516-2	*	01
LEFT HAND INBOARD ELEVON PLUNGER	V070-198259-001	*	01
THERMAL BARRIER SEAL	V070-298108-013	*	01
THERMAL BARRIER	V070-298116-005	*	01
EXTRAVEHICULAR ACTIVITY HATCH COVER	V070-316319-009	*	01
PURGE SYSTEM TUBE	V070-385018-001	*	01
RIGHT HAND WING DUCT	V070-385190-004	*	01
HEAVY WEIGHT ENGINE HEATSHIELD	V070-410364-001	1R	03

* PART NOT IDENTIFIED IN ORBITER VEHICLE OPERATIONAL CONFIGURATION CRITICAL ITEMS LIST, STS82-0039A, AS CRITICALITY 1, 1R, 2 or 2R.

Items Removed and Replaced Through Cannibalization on 61-C (STS-32/OV-102)

The following listing identifies the parts that were required through cannibalization to ready the OV-102 for mission 61-C which was launched January 12, 1986. Identified are 51 unique part numbers which represent a total of 73 cannibalization actions. These are shown in the QTY (quantity) column on the far right side of the sheet. It may be noted that some of the names are the same (for example, tape meters), but require separate part numbers due to a unique functions or configuration. Of the 51 unique parts, one was identified as Criticality 1, six as Criticality 1R, one as Criticality 2, and one as Criticality 2R.

NOMENCLATURE	PART NUMBER	CRITICALITY	QTY
LIQUID OXYGEN CURTAIN ATTACH PLATE	V070-415322	*	01
HEATER LINE	40V62HR308	*	01
BORON TUBE	70B2010-1	*	02
BORON TUBE	70B2010-4	*	01
ANTI-SLAM VALVE	73325300	*	02
AUXILIARY POWER UNIT CONTROLLER	MC201-0001-0055	*	02
AUXILIARY POWER UNIT INSULATION	MC271-0080-0932	*	01
LEFT HAND WING RELIEF VENT DOOR	MC284-0539-0004	*	01
DISPLAY DRIVER UNIT	MC409-0023-0003	1R	01
HEADS UP DISPLAY ELECTRONIC UNIT	MC409-0096-0012	*	01
PILOT DISPLAY UNIT	MC409-0096-0021	*	01
SURFACE POSITION INDICATOR	MC432-0221-0031	*	01
TAPE METER	MC432-0232-0008	*	01
TAPE METER	MC432-0232-0009	*	01
TAPE METER	MC432-0232-0010	*	01
TAPE METER	MC432-0232-0012	*	01
TAPE METER	MC432-0232-0015	*	01
TAPE METER	MC432-0232-0017	*	01
TAPE METER	MC432-0232-0018	*	01
AFT MASTER EVENTS CONTROLLER	MC450-0016-0005	*	01
PULSE-CODE MODULATION MASTER UNIT	MC476-0130-0708	2R	01
CENTRAL PROCESSING UNIT	MC615-0001-0209	1R	02
INPUT/OUTPUT PROCESSOR	MC615-0001-0312	1R	03
MULTIPLEXER/DEMULTIPLEXER	MC615-0004-5310	1R	01
MULTIPLEXER/DEMULTIPLEXER	MC615-0004-6110	1R	03
DISPLAY UNIT	MC615-0006-0112	*	03
EXTERNAL TANK PURGE FLEXLINE	ME271-0100-0002	*	01
AIRLOCK DUCT	ME276-0037-0012	*	01
INSULATION BLANKET	ME364-0014-0001	*	01
INSULATION BLANKET	ME364-0014-0002	*	01
INSULATION BLANKET	ME364-0014-0004	*	03
LEFT HAND WING SPAR INSULATOR	V070-190307-001	*	01
RIGHT HAND WING SPAR INSULATOR	V070-190313-002	*	01
LEFT HAND INBOARD ELEVON PLUNGER	V070-198259-001	*	01
EXTRAVEHICULAR ACTIVITY HATCH COVER	V070-361319-009	*	01
BLANKET FITTING ASSEMBLY	V070-362459-001	*	01
PURGE/VENT/DRAIN DUCT COVERT	V070-384143-005	*	01
PAYLOAD BAY DUCT ASSEMBLY	V070-384196-006	*	01

NOMENCLATURE	PART NUMBER	CRITICALITY	QTY
PURGE/VENT/DRAIN DUCT RETAINER	V070-384291-001	*	02
PURGE/VENT/DRAIN DUCT RETAINER	V070-384292-001	*	02
PURGE/VENT/DRAIN DUCT RETAINER	V070-384293-001	*	02
PURGE/VENT/DRAIN DUCT RETAINER	V070-384293-002	*	02
HEAVY WEIGHT ENGINE HEATSHIELD	V070-410364-001	1R	03
HYDROGEN VENT PORT	V070-454720-004	2	01
BUNGEE ASSEMBLY	V070-510101-008	1	01
NOSE GEAR LANDING ASSEMBLY	V070-510502-015	*	02
CLOSEOUT PANEL	V070-731502-004	*	01
SUPPORT ASSEMBLY	V544-366206-001	*	04
SUPPORT ASSEMBLY	V544-366207-003	*	01
ROD END ASSEMBLY	V070-350200-001	*	01
PURGE/VENT/DRAIN DUCT	V070-385116-003	*	01

* PART NOT IDENTIFIED IN ORBITER VEHICLE OEPRATIONAL CONFIGURATION CRITICAL ITEMS LIST, STS82-0039A, AS CRITICALITY 1, 1R, 2 or 2R.

Mr. OWEN. Sir, I can't respond to that one specifically, but I would propose to say that probably most of them in every case would probably be a criticality-1 item.

Mr. PACKARD. So, each of them had significant potential for problems if, in fact, it resulted in malfunctioning.

On the overtime, you indicated that there would be—to correct that there would be a substantial increase in personnel as we get toward launch again.

Dr. Fletcher has indicated that we will at least begin to launch at a rate of 12 per year, and you have indicated that that will—that we will need to have an increase of personnel, three continuous 7-day-a-week shifts.

We were running at about 15 flights a year at the time, trying to move up to 24, and that created a significant pressure on the scheduling.

How long did—during that high period of overtime—how long did any single shift work on a continuous basis?

Mr. OWEN. Well, if you talk about a total shift working, I would say that it would be—if we talk by shift it would be the Morton Thiokol area where we had the people over there involved in stacking in 12-hour shifts.

Mr. PACKARD. How long did any specific individual work continuously?

Mr. OWEN. I don't have that data in front of me to refer to. I do have the data.

Mr. KENNEDY. In the case of the SRB stacking operation which does work 12-hour shifts, that is worked for 1 week. We complete the stack of both SRB's in 1 week.

The rest of that month they are on normal 8-hour shifts.

Mr. PACKARD. I would have to assume that in those 12-hour shifts there were some critical people as we would delay flights and look for a flight the next day—sometimes, in one case, seven cases, we delayed the flight—that some critical people would be there probably much more than a shift would be. Is that correct?

Mr. KENNEDY. No, sir, not in our case. We limit our people to 12 hours in any one 24-hour period.

Mr. ROE. Can the gentleman suspend and we will go vote and pick up with you when the committee returns.

Mr. PACKARD. Fine.

Mr. ROE. The committee will recess and go vote, and we will be right back.

[Recess.]

Mr. ROE. The Chair recognizes the gentleman from California, Mr. Packard.

Mr. PACKARD. Thank you again, Mr. Chairman. The point I wanted to pursue a little bit was the interrelationship between the cannibalizing, the overtime, et cetera, and the fact that you have indicated that you intend to increase the personnel in order to accommodate a 12-flight per year schedule with 3 orbiters, when we were unable to accommodate, or certainly we did not have an increase of personnel when we had a 15-flight and an increasing to 24 flights, and often delays that would delay the next flight or certainly impinge into the preparation for the next flight—how did we accommodate—how could you accommodate when you now recog-

nize that you have to have increased personnel to accommodate 12 flights per year with 3 orbiters? How were we able to do it?

Mr. OWEN. Basically we responded in the overtime area to cover the activities that were accomplished on Saturdays and Sundays, and some extended into in-week overtime to perform the work that was required to be done within the launch schedule that was given us.

The idea of planned management on 7 days, three shifts, puts you in a position to work the people on what you would consider a normal 40-hour week, thereby to perform these tasks and in essence give you some additional 20 percent or so work time within the particular week for process.

Mr. PACKARD. Now that we are shut down for a period of time, how many of your current employees do you anticipate you may lose before we fly again in another year and a half?

Mr. OWEN. Well, we have been working some scenarios with our customer, NASA, on this. We have been able to identify enough work with the ongoing processing that we have today and that breaks out into the orbiter processing that is continuing to go on.

The structural inspections that we have in line for us before we fly again on all the orbiters—we have a backlog of some 377 vehicle modifications that can be performed between now and the next launch period.

We continue to work on our documentation system improvements, our procedures and instruction improvements, more intensified training of the work force, and returning our ground systems back to flight status, performing the enhancements on our GSE and facilities.

We also have a pressure vessel recertification program. We have some 1,800 pressure vessels that have to be recertified. We have our total facility corrosion control plan that has to continue to be worked. We have our Centaur modifications that we made on the pads and the vehicles that have to be removed.

So what I guess I am saying is that we have identified a tremendous amount of work that needs to be done and can keep our work force intact, depending on—how successful NASA is with satisfying this for their budget demands will depend on what kind of work force that we have.

Mr. PACKARD. So you do not anticipate an interim reduction in the work force?

Mr. OWEN. I say that—I can say that with tongue in cheek. Now that we have the new launch date, we will have to look at that and I am sure that we possibly will have a slight reduction. I just can't give you a figure on it.

Mr. PACKARD. In your testimony, at least your printed testimony, you indicated you are looking at a program of stationizing, kind of an assembly line type of thing where people stay in one station.

What is your impression of that?

Mr. OWEN. We have implemented that and have had that for quite some time. Our impression of it is it is very good. The people, the employees seem to like it very well. This is, of course, implemented in the OPF area, where we process the vehicle.

We like it because of the employees becoming familiar with just certain sections of the orbiter where they are normally assigned

work. We break them out into three different categories, the forward, the mid and the aft sections, and the employees can become better familiarized with that particular section and get more confident in their work.

Mr. PACKARD. Before I leave the whole issue of overtime and cannibalizing, let me ask one last question in that area. If you had no cannibalizing requirement, if, for all intents and purposes, each shuttle was able to sustain its own component requirements, how much overtime would you still have to have met the scheduling that we were operating under at the time of the accident?

Mr. OWEN. Sir, that would be just more a guess on my part, but I would say we could have probably eliminated the overtime—the overtime that we worked by maybe 20 percent.

Mr. PACKARD. So it certainly wouldn't eliminate the overtime requirements?

Mr. OWEN. No, sir, absolutely not, but it was a big factor.

Mr. PACKARD. Are you saying then that the schedule was just too ambitious?

Mr. OWEN. A tremendous amount of work, you have to understand, was to be accomplished during that period of time. We work out programs with NASA and what have you to—and in this timeframe for holidays, we were trying very much, and polled the people and talked to them about the possibility of working added overtime to try to get some of these missions and things behind us so that they could have the holidays off. That was one factor that did increase the overtime level somewhat during that period of time.

We have had quite a few launch scrubs due to weather, as you know. We also were caught where we had at least one flight that was scheduled on a weekend.

Mr. PACKARD. One last question, Mr. Chairman.

The Rogers Commission report describes on the *Challenger* mission, where the accident happened, how the critical liquid hydrogen 17-inch disconnect valve opened inadvertently through a procedural error on the console. This had the potential of creating a catastrophe in and of itself, but was not uncovered until after the accident.

What procedures do you have for this type of an incident in terms of reporting them immediately and what instructions do your employees have in regard to these kinds of circumstances?

Mr. OWEN. Sir, the procedure calls for, when an error is made by anyone, that they report it and we put in a problem report immediately. This was a human error and the employee, the engineer managing the console did not recognize that he had made an error, so therefore a PR was not generated. It was only after data reduction that it was discovered that there had been an error made.

Mr. PACKARD. And what would have been the outcome of that error had the flight gone on as—without mishap?

Mr. OWEN. That is somewhat subjective. A possibility, as you said it could have been disastrous, but there is also a possibility that it would not have, that it would have went ahead and achieved the orbit.

Mr. PACKARD. I think in conclusion, Mr. Chairman, it certainly appears that with the myriads of concerns and problems in a varie-

64-548 O—86——5

ty of areas, the O-ring discussion with all of its lack of testing or inadequate testing for low temperatures that we discussed 2 or 3 weeks ago in our hearings, and the pressures of schedule, the problems of cannibalizing, it appears to me that an accident was almost inevitable at some point in time, whether it be on 51-L or some subsequent flight.

This certainly, this whole problem, unfortunate as it is, certainly has given us a chance to evaluate what has to be done to put us into a position where accidents are not an inevitability. I certainly hope that we will make the proper moves to prevent any future inevitable accident such as this.

Thank you.

Mr. ROE. I thank the gentleman from California.

The Chair recognizes the distinguished gentleman from Florida, Mr. Lewis.

Mr. LEWIS. Thank you, Mr. Chairman.

What I am generally interested in is what type of inspection plan do you overall have at SPC in respect to the initial setup, getting the orbiter into position to go for a launch? What is the overall inspection system available? Who is responsible for signoffs—you mentioned earlier, the gentleman from Thiokol, that you had an excellent team and you worked integratedly, you were integrated and worked as a great team.

Does Thiokol sign off and report to someone as the other systems people sign off and report to someone? How is this generated into a when we are ready to launch situation?

Mr. SARGENT. Let me try that.

The inspection system is designed to reinforce the design and the processing package of requirements that are completely defined and agreed to. Then there is in the case of Morton Thiokol, they have their own quality assurance and their own inspectors for the solid rocket motor and we have other inspectors in other areas. We normally specialize so that the inspectors are able to learn and specialize in their job.

Along the way if there is anything that does not fit within that package of requirements, it is flagged and there is paperwork generated which requires resolution before you can proceed.

Mr. LEWIS. Does everything come to a stop there or do you work around this—does this continue elsewhere as far as——

Mr. SARGENT. I think it would depend on where the thing was. If you had several parallel tasks going not everything would stop but you would not proceed with that discrepancy until the necessary paperwork was processed to allow to proceed and accept that.

Mr. LEWIS. What does SPC—how do they interface with the actual pushbutton at the time of launch?

Mr. SARGENT. The SPC is in the firing room. They are operating most of the consoles. The SPC is also present in the room with the senior NASA officials.

We also operate—the entire organization operates backup firing rooms where the development contractors as well as the SPC and NASA are present there so there is a lot going on at that time during the final countdown, if I understood the question properly.

Mr. LEWIS. That is correct.

The gentleman from California asked you some questions on overtime. We now have three orbiters. In order to meet an ambitious schedule, do you strongly feel that we need a fourth orbiter and how are you going to provide the manpower for that if necessary?

Mr. SARGENT. Certainly a fourth orbiter would help the schedule considerably, but there are other things that would enhance it. One we mentioned is spare parts. That is a killer as far as schedule. Unplanned modifications are very difficult for us. Several changes would come down late in the schedule that we would have to plan in and again work out of schedule.

I think those two are the main two. The unplanned work, and it can be in the form of modifications or it can be a change in manifest and the logistics.

Mr. LEWIS. With the—do you feel that during the normal launching schedule, whatever normal launching schedule would be, that you would require overtime in order to meet a launch; is it a standard operating procedure?

Mr. SARGENT. I think we will always have some overtime. There are always situations where you want your specialists working on resolving a problem, for instance, a launch abort, or where you have to save the vehicle or where you have in the area of stacking, where you need—once you have started a delicate or a potentially hazardous operation, you need to keep going, so we never will get away from overtime. In fact, in that case, I think you would not want to.

Where we want to get away from overtime is where there is normal shift work. One of the things we found that our people are very dedicated and very motivated on the program and they will work a good number of overtime hours, but where you come up with an unplanned requirement where they have something planned with the families and have to work overtime, that is deadly. There will be critical areas that we will always be working overtime.

Mr. LEWIS. What do you do with an ambitious launching schedule where you get to a point where regardless of whether or not your people are loyal and highly qualified, they meet a saturation point as far as needing rest? Are you in a position and is the SPC strong enough to say, we stop now and hold for 24 hours before we go again so our people can get some rest? Are you in a position to do that?

Mr. SARGENT. I feel we are.

Mr. LEWIS. Have you ever done it?

Mr. SARGENT. Not in the case of a launch, we have never been in that position.

Mr. LEWIS. Why not?

Mr. SARGENT. We have never found ourselves where we felt the critical people in the firing rooms were in that mode. We have in processing delayed a move out to the next station or something like that because we felt we should delay it.

Mr. LEWIS. I would like to talk about cannibalizing from one orbiter to another. Once that happens, you pull a computer head or what have you out of the orbiter and replace it with one from another orbiter in order to continue moving and I have no objections

to this; I am concerned about who is responsible for the reinspection and recertification of that part going back into the other orbiter, not the one being launched but the other orbiter.

Mr. SARGENT. That is the SPC. We would use the same procedures as if a component had failed in that source of the part. When we replace it, we would run through the same testing and acceptance that we would on any other.

Mr. ROE. Would the gentleman yield?

I think it is important to get into the record, who makes the decision to cannibalize in the first place?

Mr. SARGENT. I think that is primarily the NASA operations folks at Kennedy, if you are talking about going to orbiter 3 and removing——

Mr. ROE. It seems to me what is important to get on the record is that we are dealing with 730 criticality items, No. 1.

Mr. Owens testified earlier to the point of view that when the question was asked, well, of those items that have been cannibalized, in his judgment were mostly criticality items and the answer is, in his judgment, he thought they were. Then the second question was asked, we are talking about whether we get the fourth orbiter, we come back and say of the cannibalization that took place that each one of the three orbiters that exist have been cannibalized.

I think that is No. 2 and No. 3, and following the gentleman from Florida's line of questioning is that the whole concern of the quality testing which was Mr. Packard's earlier thought process, when you take a part out of something like taking it out of a brand-new automobile, it is not that simple in quality control to just put a new part back in. That concerns the committee, and No. 4, what is concerning the committee was the point when the developers of the hardware came back and expressed unanimously their concern with the umbrella process we are talking about because they felt that part of the quality control was lost in that transition.

I think basically that is where we are coming from in that line of questioning. What kind of answer do we get? Who decides to cannibalize the part and then does the responsibility go back to your team to replace it? How does that work and how many parts are cannibalized?

Mr. SARGENT. Many parts are cannibalized. I think it is the decision of when, literally, to remove a line replaceable unit is the NASA folks at Kennedy.

Mr. ROE. You have no authority whatsoever to take any part off any machine without the approval of NASA?

Mr. OWEN. That is correct. We apprise them of the situation because NASA has the responsibility to furnish the parts.

Mr. ROE. Do they have to give you permission, is what I am trying to get at?

Mr. OWEN. Yes; absolutely.

Mr. ROE. Do you request it——

Mr. OWEN. We request permission to remove a part, they concur with it and also the development contractor who is responsible for furnishing the spare parts, the logistics contractor has to sign off and approve it; he has to justify to NASA that there is no other way to supply that part.

Mr. ROE. Are we saying, No. 1, that NASA itself, somebody there, decides that a part can be cannibalized?

Mr. OWEN. That is correct.

Mr. ROE. You follow that procedure?

Mr. OWEN. Absolutely.

Mr. ROE. Then the contractors who are providing the proprietary equipment, they are notified that that part is going to be cannibalized and it will have to be replaced with a spare part and the proprietary contractor has to certify, is that the process?

Mr. OWEN. No, sir. We make a demand for the part from our own logistics organization. If we have a spare part in our logistics, then we can use that to satisfy the item. If we do not have it there, then we request it from the development contractor, normally Rockwell, that has the logistics support contract, a demand for that part. They then look in their supply system they have, either pipeline or vendor source or whatever it is and give us a date or a time that they can have a part onboard.

If that will not satisfy the requirement, then this is reported to NASA. We are asked for a decision from them about whether to cannibalize a part or what we should do. They make the decision where it would come from, pick the vehicle which we take the part from and make the decision depending on where it is in the process and what has been tested or not tested.

Mr. ROE. Can you provide either now or for the record, of the three existing orbiters, which I think is a very important question, of the three existing orbiters, how many parts have been cannibalized and how many parts are we short on making those three units whole? Can you provide that for the record?

Mr. OWEN. I don't have the data with me, but we can certainly provide it to you, and we will.

Mr. ROE. I particularly want that information. I think it is very important.

[The information follows:]

CANNIBALIZATIONS ON REMAINING THREE ORBITERS

The following listings of parts cannibalized from the remaining three orbiters since their latest flight, and the parts missing from each of the orbiters as of July 16, 1986, are provided. As identified on the listings of missing parts, some items were removed for reasons other than cannibalization (e.g., shipment to a maintenance location for repair or modification). These parts shortages are reviewed with NASA and Rockwell on a daily basis.

OV-102

The latest mission of Orbiter OV-102 was flown on January 12, 1986. Since that date, no parts have been cannibalized from OV-102 to support the processing schedule of other orbiters. OV-102 is currently undergoing processing in preparation for transfer to Vandenberg Air Force Base. As a result of the processing activity, on July 16, 1986, there were seven parts missing which did not include miscellaneous small parts (i.e., nuts, bolts, brackets). One of these parts is listed in the NASA Critical Items List (CIL) as a 2R.

Parts Removed From OV-102 for All Reasons and Missing as of 7/16/86:

NOMENCLATURE	PART NUMBER	CRITICALITY	QTY
PULSE-CODE MODULATION MASTER UNIT	MC476-0130-0708	2R	01
LEFT HAND PANEL	V070-190607-025	*	01
PANEL ASSEMBLY	V070-454848-002	*	01
ANTENNA ASSEMBLY	V070-742560-017	*	01
ANTENNA ASSEMBLY	V070-742560-020	*	01
POWER CONTROL ASSEMBLY	V070-765310-007	*	01
POWER CONTROL ASSEMBLY	V070-765600-001	*	01

* PART NOT IDENTIFIED IN ORBITER VEHICLE OPERATIONAL CONFIGURATION CRITICAL ITEMS LIST, STS82-0039A, AS CRITICALITY 1, 1R, 2 or 2R.

OV-103

The latest mission of the Orbiter OV-103 was flown on August 27, 1985. Since the next scheduled mission (before the accident) was the Vandenberg mission and Orbiters 099, 102, and 104 were scheduled to fly before the VLS scheduled launch date, Orbiter 103 became the primary vehicle from which parts were cannibalized. This is the reason for the unusually high number of parts cannibalized. The last section of this listing shows the number of parts that were missing as of July 16. There are 14 unique part numbers which represent 29 items which had not been replaced.* Five of the 14 part numbers are listed in the NASA Critical Items List as 1R.

- In some cases (for example, the fuel cell), there are more parts missing than were cannibalized which resulted from an additional two being removed for problem reports (i.e., hardware failure).

Cannibalizations from OV-103 since last launch on 27 August 1985:

NOMENCLATURE	PART NUMBER	CRITICALITY	QTY	MISSING (7/16/86)
LIQUID SENSOR	SV766516-2	*	01	**
FLIGHT ACCELERATION SAFETY CUTOFF SYSTEM BOX	4095004-5005	*	01	**
HEATER LINE	40V62HR308	*	01	**
BORON TUBE	70B2010-1	*	01	**
BORON TUBE	70B2010-301	*	01	**
BORON TUBE	70B2010-4	*	02	**
ANTI-SLAM VALVE	73325300	*	01	**
AUXILIARY POWER UNIT CONTROLLER	MC201-0001-0055	*	02	**
AUXILIARY POWER UNIT INSULATION	MC271-0080-0932	*	01	**
LIQUID OXYGEN RELIEF VALVE	MC284-0406-0002	1R	01	**
UNDERLOADER VALVE	MC284-0438-0001	1R	01	**
LEFT HAND WING RELIEF VENT DOOR	MC284-0539-0004	•	01	02 ###
DISPLAY DRIVER UNIT	MC409-0023-0002	1R	01	**
DISPLAY DRIVER UNIT	MC409-0023-0003	1R	02	01
KU BANK DEPLOYMENT ASSEMBLY	MC409-0025-3005	1	01	**
HEADS UP DISPLAY ELECTRONIC UNIT	MC409-0096-0012	*	01	**
PILOT DISPLAY UNIT	MC409-0096-0021	*	02	**
SURFACE POSITION INDICATOR	MC432-0221-0031	•	01	**
TAPE METER	MC432-0232-0008	*	01	01 #
TAPE METER	MC432-0232-0009	*	01	01 #
TAPE METER	MC432-0232-0010	*	01	01 #
TAPE METER	MC432-0232-0012	*	01	01 #
TAPE METER	MC432-0232-0015	*	01	01 #
TAPE METER	MC432-0232-0017	*	01	01 #
TAPE METER	MC432-0232-0018	•	01	01 #
AFT MASTER EVENTS CONTROLLER	MC450-0016-0005	*	01	**
FUEL CELL	MC464-0115-3001	1R	01	03 ##
PAYLOAD DATA INTERLEAVE	MC476-0136-0004	*	01	**
CENTRAL PROCESSING UNIT	MC615-0001-0209	1R	03	**
INPUT/OUTPUT PROCESSOR	MC615-0001-0312	1R	03	**

NOMENCLATURE	PART NUMBER	CRITI- CALITY	QTY	MISSING (7/16/86)
MULTIPLEXER/DEMULTIPLEXER	MC615-0004-5310	1R	01	**
MULTIPLEXER/DEMULTIPLEXER	MC615-0004-6110	1R	03	**
MULTIPLEXER/DEMULTIPLEXER	MC615-0004-6210	1R	02	**
DISPLAY UNIT	MC615-0006-0112	2R	03	**
ORBITER MANEUVERING SYSTEM CONTROLLER	MC621-0009-0125	*	01	**
BOLT	MD111-4024-0622	*	01	**
NUT	MD114-3005-0006	*	01	**
WASHER	MD153-1002-0006	*	01	**
WASHER	MD153-5004-0006	*	01	**
PURGE SYSTEM TUBE FITTING	MD273-0025-1006	*	04	**
PREFORMED SEAL	MD273-0026-0006	*	04	**
EXTERNAL TANK PURGE FLEXLINE	ME271-0100-0002	*	01	**
CONNECTOR	ME273-0125-0004	*	01	**
PURGE SYSTEM TUBE FITTING	ME273-0127-0004	*	01	**
AIRLOCK DUCT	ME276-0037-0012	*	01	**
AIRLOCK DUCT CLAMP	ME277-0007-0009	*	01	**
INSULATION BLANKET	ME364-0014-0001	*	01	**
INSULATION BLANKET	ME364-0014-0002	*	01	**
INSULATION BLANKET	ME364-0014-0004	*	03	**
HOSE, CLAMP	NAS1922-0875-1H	*	01	**
HOSE, CLAMP	NAS1922-0525-1H	*	01	**
NOSE LANDING GEAR TIRES	MC194-0007-0002	1	02	**
PULSE-CODE MODULATION MASTER UNIT	MC476-0130-0708	2R	02	**
LEFT HAND WING SPAR INSULATOR	V070-190307-001	*	01	**
RIGHT HAND WING SPAR INSULATOR	V070-190313-002	*	01	**
LEFT HAND CARRIER PANEL	V070-194122-001	*	01	**
SUPPORT BRACKET	V070-194128-002	*	01	**
DEBRIS PANEL	V070-336397-001	*	01	**
DEBRIS PANEL	V070-336398-001	*	02	**
HOOK FITTING	V070-366921-001	*	01	**
EXTRAVEHICULAR ACTIVITY HATCH COVER	V070-361319-009	*	01	**
BLANKET FITTING ASSEMBLY	V070-362459-001	*	01	**
PURGE/VENT/DRAIN COVER	V070-384143-005	*	01	**
PAYLOAD BAY DUCT ASSEMBLY	V070-384196-006	*	01	**
SPACER	V070-384211-001	*	07	**
PURGE/VENT/DRAIN RETAINER	V070-384291-001	*	02	**
PURGE/VENT/DRAIN RETAINER	V070-384292-001	*	02	**
PURGE/VENT/DRAIN RETAINER	V070-384293-001	*	02	**
PURGE/VENT/DRAIN RETAINER	V070-384293-002	*	02	**
PURGE SYSTEM TUBE	V070-385018-001	*	01	**
AFT DUCT ASSEMBLY	V070-385114-003	*	01	**
FORWARD DUCT	V070-385226-003	*	01	**
HEAVY WEIGHT ENGINE HEATSHIELD	V070-410364-001	1R	01	**
HYROGEN VENT PORT	V070-454720-004	2	01	**
BUNGEE ASSEMBLY	V070-510101-008	1	01	**
MAIN LANDING GEAR UPLOCK SPACER	V070-510176-001	*	01	**
MAIN LANDING GEAR UPLOCK SPACER	V070-510177-001	*	01	**
MAIN LANDING GEAR UPLOCK SPACER	V070-510185-001	*	01	**
NOSE GEAR LANDING ASSEMBLY	V070-510502-015	*	02	**

CLOSEOUT PANEL	V070-731502-004	*	01	**
GENERAL PURPOSE COMPUTER CABLES	V070-778231-201	*	01	**
GENERAL PURPOSE COMPUTER CABLES	V070-778232-201	*	01	**
SUPPORT ASSEMBLY	V544-366206-001	*	04	**
SUPPORT ASSEMBLY	V544-366207-003	*	01	**
FLOODLIGHT BRACKET WASHERS	V549-704023-001	*	03	**
PURGE/VENT/DRAIN DUCT SPACER	V566-384010-001	*	04	**
PAYLOAD SERVICE AREA HANDHOLD	V568-650783-001	*	03	**
LEFT HAND CARRIER PANEL	V070-194121-001	*	01	**
LEFT HAND INBOARD ELEVON PLUNGER	V070-198259-001	*	01	**
THERMAL BARRIER SEAL	V070-298108-013	*	01	**
THERMAL BARRIER	V070-298116-005	*	01	**
ROD END ASSEMBLY	V070-350200-001	*	01	**
PURGE/VENT/DRAIN DUCT	V070-385116-003	*	01	**
SPACER	V070-391118-001	*	01	**
SPACER	V070-391118-002	*	01	**
SHIM	V070-391120-001	*	120	**
SHIM	V070-391120-002	*	24	**
SHIM	V070-391120-003	*	50	**
SPACER	V070-391121-001	*	02	**
GENERAL PURPOSE COMPUTER CABLES	V070-778233-201	*	01	**

* PART NOT IDENTIFIED IN ORBITER VEHICLE OPERATIONAL CONFIGURATION CRITICAL ITEMS LIST, STS82-0039A, AS CRITICALITY 1, 1R, 2 or 2R.

** CANNIBALIZED PART REPLACED PRIOR TO 16 JULY 1986

TOTAL DELIVERED FLIGHT SETS LESS THAN THE NUMBER OF ORBITERS.

IN ADDITION TO THE ONE CANNIBALIZED, TWO FUEL CELLS WERE REMOVED DUE TO PROBLEM REPORTS AND SHIPPED TO REPAIR.

ONE VENT DOOR REMOVED DUE TO CANNIBALIZATION. IN ADDITION VENT DOOR WAS REMOVED DUE TO PROBLEM REPORTS AND SHIPPED TO REPAIR.

Parts Removed From OV-103 for All Reasons (Including Cannibalization) and Missing as of 7/16/86:

NOMENCLATURE	PART NUMBER	CRITICALITY	QTY
AUXILIARY POWER UNIT	MC201-0001-0201	*	03
LEFT HAND WING RELIEF VENT DOOR	MC284-0539-0004	1R	02 #,##
RADIO FREQUENCY ASSEMBLY	MC409-0017-0003	1R	01
DISPLAY DRIVER UNIT	MC409-0023-0002	1R	01 #
BRAKE VALVE	MC621-0055-0019	1R	04
RE-INFORCED CARBON CARBON "T" ASSEMBLY	V070-199806-020	*	01
ANTENNA ASSEMBLY	V070-742560-018	*	01
ANTENNA ASSEMBLY	V070-742560-019	*	01
ANTENNA ASSEMBLY	V070-742560-020	*	01
PANEL	MC434-0219-0005	*	01
WASTE COLLECTION SYSTEM	MC282-0069-08XX	*	01
FUEL CELLS	MC464-0115-3001	1R	03 #,###
ORBITER MANEUVERING SYSTEM PODS	73A000000-XXXX	*	02
TAPE METER (SET)	MC432-0232-00XX	*	07 #

* PART NOT IDENTIFIED IN ORBITER VEHICLE OPERATIONAL CONFIGURATION CRITICAL ITEMS LIST, STS82-0039A, AS CRITICALITY 1, 1R, 2 or 2R.

\# ITEMS CANNIBALIZED.

\## ONE VENT DOOR REMOVED DUE TO CANNIBALIZATION. AN ADDITIONAL VENT DOOR WAS REMOVED DUE TO A PROBLEM REPORT AND SHIPPED TO REPAIR.

\### IN ADDITION TO THE ONE CANNIBALIZED, TWO FUEL CELLS WERE REMOVED DUE TO PROBLEM REPORTS. ALL HAVE BEEN SHIPPED TO VENDOR FOR MODIFICATION.

OV-104

The latest mission of Orbiter OV-104 was November 28, 1985. Since that date, eleven unique parts numbers were cannibalized (13 items), two of which are listed as Criticality 1R as identified in the NASA Critical Items List as of July 16, 1986. There are nine unique parts missing (22 items), four of which are identified as Criticality 1R. These do not include miscellaneous small parts (i.e., nuts, bolts, brackets).

Cannibalizations From OV-104 Since Last Launch on 28 Nov 1985:

NOMENCLATURE	PART NUMBER	CRITI-CALITY	QTY	MISSING (7/16/86)
INPUT/OUTPUT PROCESSOR	MC615-0001-0312	1R	01	**
TAPE METER	MC432-0232-0008	*	01	01 #
TAPE METER	MC432-0232-0009	*	01	01 #
TAPE METER	MC432-0232-0010	*	01	01 #
TAPE METER	MC432-0232-0012	*	01	01 #
TAPE METER	MC432-0232-0015	*	01	01 #
TAPE METER	MC432-0232-0017	*	01	01 #
TAPE METER	MC432-0232-0018	*	01	01 #
EXTRAVEHICULAR ACTIVITY HATCH COVER	V070-361319-009	*	01	**
RIGHT HAND WING DUCT	V070-385190-004	*	01	**
HEAVY WEIGHT ENGINE HEATSHIELD	V070-410364-001	1R	03	01 #

Parts Removed for All Reasons (Including Cannibalization) and Missing as of 7/16/86:

NOMENCLATURE	PART NUMBER	CRITICALITY	QTY
AUXILIARY POWER UNIT	MC201-0001-0201	*	03
DISPLAY DRIVER UNIT	MC409-0023-0002	1R	01
STARTRACKER	MC431-0128-0013	1R	01
BRAKE VALVE	MC621-0055-0019	1R	04
FORWARD FUEL PROBE	73A620089-1009	•	01
HEAVY WEIGHT ENGINE HEATSHIELD	V070-410364-001	1R	01 #
SPACE SHUTTLE MAIN ENGINE	RS007001-001	*	03
WASTE COLLECTION SYSTEM	MC282-0069-0885	*	01
TAPE METER	MC432-0232-00XX	*	07 #

* PART NOT IDENTIFIED IN ORBITER VEHICLE OPERATIONAL CONFIGURATION CRITICAL ITEMS LIST, STS82-0039A, AS CRITICALITY 1, 1R, 2 or 2R.

** CANNIBALIZED PART REPLACED PRIOR TO 16 JULY 1986.

TOTAL DELIVERED FLIGHT SETS LESS THAN THE NUMBER OF ORBITERS.

ITEMS CANNIBALIZED AND STILL MISSING.

Mr. ROE. The gentleman from Florida.

Mr. LEWIS. Thank you, Mr. Chairman.

In your presentation on page 7, you point out that the designated verifier program is limited to noncritical ground support equipment systems and facilities. Then we go to page 19 and you point out, we are carefully reviewing the designated program with NASA to ensure that it does not introduce weakness into the safety and quality assurance program.

I think you would always have an ongoing review as far as quality assurance, but why are you concerned about safety if it is limited, as you pointed out, in support equipment and noncritical ground support equipment?

Mr. SARGENT. One of the main things is to respond to the Rogers Committee and review the designated verifier system and make sure that is where we want to end up. We are satisfied that the designated verifier program is properly implemented and utilized.

Mr. LEWIS. Does the designated verifier take the place of an independent inspector?

Mr. SARGENT. Well, in some ways you might say he does. There are cases where designated verifiers are also the person doing the work in a noncritical area such as checking air pressure in a tire or something. You might have the tractor driver check the tire. The penalty there would be if he failed to do his job right, we would have time lost when you went to use the tractor.

Usually, the designated verifier effort is in those general areas where it is not directly relatable to reliability or safety, and usually there are subsequent checks. It is usually a value-added check that he is performing as opposed to a first-line quality or safety.

Mr. LEWIS. Do you as a matter of procedure after each launch have a critique as far as quality review pertaining to that launch to see what mistakes could have been made or not made, and what improvements that could be made for the next one?

Mr. SARGENT. We go through the things that are anomalous, and make sure we take care of them before the next approach.

Mr. LEWIS. What levels are involved in this type of critique with the SPC, management levels?

Mr. SARGENT. Usually at the director level.

Mr. LEWIS. Are any line people involved in this at all?

Mr. KENNEDY. I can speak for the SRB, and the ET processing. I am not that familiar with how the orbiter people do it. I think it is similar.

We have what we call a postlaunch or, if we do it in sequences, postoperation review, which consists of the safety, quality, operations people that actually did the work, the engineering people, and the members of the LSS, the launch support system contractor engineering staff, come into that. I attend those, and the supervisor who is responsible for that phase of the operation. For instance, if we stack the SRB's, after the stacking of the SRB's, that particular set of SRB operations are reviewed by the supervisor who is responsible for the operation and the quality personnel who inspected it.

We go through and look at any anomalies, any what we call problem reports, or PR's, that are written during that flow, evalu-

ate what the resolution of them was and assure that they don't happen again.

In the case of problem reports, there is a documentation system which requires corrective action to be established on the problem reports. If it turns out that we had a defective part that was furnished by a development contractor which we had to either replace or to get what we call a material review board action on, that is documented and given back to the development contractor as a piece of paper, and he has responsibility to NASA to respond to that through a cause and corrective action that says what he is going to do to prevent a similar defective part from reaching the field again.

It is an elaborate quality control paperwork control system. We review those, what was done well or not well, what we need to change, either the procedures or the processes, before we do the job again; and any open items from previous reviews that have not been taken care of. We do that on every flow of the SRB or ET and there are six operations.

We are stationized and that same job is done repetitively in those stations so when we complete a job at a given station we have a postoperations review of those activities on that set of hardware.

Mr. LEWIS. I certainly don't want to beat this particular area to death, but after the recovery of the SRB's, is that also part of the quality review that you just mentioned?

Mr. KENNEDY. No, sir. The SRB's are recovered by the SPC, brought back to land and removed from the water and placed in handling equipment; but the actual inspection, the postflight inspection of that hardware is done by the development contractor engineering teams and not by SPC.

Mr. LEWIS. I guess after all these months, I still have not been able to pin down the problem with that field joint, Mr. Chairman, and I guess I won't be able to pin it down here, but what has the safety record of the SPC been that you have, Mr. Sargent, compared to the record prior to your contract?

[The information follows:]

SAFETY RECORD COMPARISON

Data available to the SPC team reflects a significant reduction in the number of reportable mishaps (damage exceeding $500) since the SPC team assumed the Shuttle processing responsibilities from the development contractors.

There has been a dramatic increase in the amount of ground processing activity at Kennedy Space Center since the transition to the SPC concept. Since SPC took over, there has been significant increase in the number of launches per year, the number of orbiters being processed (one to four orbiters), the number of Mobile Launch Platforms (MLPs) in use (one to three MLPs), and the number of launch pads in use (one to two) over the entire period of time. For example, during mid-1982, the element contractors were processing one orbiter, using one MLP, and one launch pad. There were three launches in 1982. During mid-1985, LSOC was processing four orbiters, using three MLPs and two launch pads. There were nine highly successful launches in 1985.

The ground safety record at Kennedy has improved dramatically since the SPC team began processing shuttles. Government data reflects a favorable comparison to the record prior to the SPC contract. Our average monthly reportable mishap since transition is 1.48 per month while the previous contractors experienced a monthly rate of 3.179 prior to transition when the processing rate and amount of flight hardware were much lower. As I have said before, any mishap is unacceptable and we are pressing hard in our effort to drive our rate as close to zero as possible.

ATTACHMENT C

Mr. SARGENT. I believe it is much improved over the prior contract. Of course, there are several ways that you can count incidents.

The workload has continued much, is much higher. We had four orbiters, two pads, three mobile launch platforms.

When you consider all that and the additional work that was going on the rate—let's see, if I have some parameters—it was at 2.6 incidents per launch at the end and I don't recall, something like an eightfold.

I am not certain of that number, but it was about eight times higher prior to our acceptance. It has dropped dramatically. We are still not satisfied with it, but it has improved dramatically.

We have an incident error review board where every incident is reviewed by the managers led by the head of safety and quality assurance.

They review the corrective action, the situation involved in the incident, and it is presented weekly to my staff. We go through every incident that has happened that week, the circumstances behind it and look for reasons why lack of training or poor procedures or whatever, so we work very hard at that safety record.

Mr. LEWIS. Have you reviewed at this point—have you reviewed with NASA as to what you think is a reasonable launch schedule that can be adequately met by your manpower to provide the safest launch possible?

Mr. SARGENT. Well, we have had discussions—I guess we haven't reviewed a conclusive number where we sat down and made sure we both agree on all parameters, but we have looked at somewhere in the neighborhood of 12 per year, but that has got some ringers on it.

It has the requirement to improve the spare situation and it is going to require that we work on in-plant modifications and do block incorporations rather than have them come in incrementally at the last minute and throw us off pace.

We would agree 12 per year with those provisos, but we haven't sat down and had a formal agreement on what the number would be.

Mr. LEWIS. Thank you, Mr. Chairman.

Mr. Chairman, Mr. Sargent mentioned the availability of spare parts, and I recall several weeks ago that I believe there was some testimony somewhere in the record about there were no problems, that there were sufficient spare parts.

Mr. ROE. Particularly, that is not accurate.

The Chair recognizes the gentleman from Pennsylvania, Mr. Walker.

Mr. WALKER. I have a document here that I want to review with our witnesses.

I think it might be better for us to vote and come back to my questions, because I don't want to break off.

Mr. SENSENBRENNER. Mr. Chairman, just for the record, I have no questions.

Mr. ROE. We will recess for the vote and then come back and go into the questions of Mr. Walker.

[Recess.]

Mr. ROE. The committee will reconvene, and the Chair recognizes the distinguished gentleman from Pennsylvania, Mr. Walker.

Mr. WALKER. I have found in these hearings sometimes we can focus best on complex problems by looking at specific examples, and I have one here that I would like to follow through a little bit, Engineering Awareness Bulletin E9, dated 22 August, 1985, which is entitled "Part Substitution." I ask unanimous consent that that memo be included in the record at this point and that it be provided to the members and to the witnesses.

Mr. ROE. Without objection, so ordered.

[The information follows:]

NO: E9 08/22/85

ENGINEERING AWARENESS BULLETIN

PARTS SUBSTITUTION

THE FOLLOWING GUIDELINES ARE TO BE FOLLOWED WHEN REPLACING STANDARD HARDWARE WITH SUBSTITUTION PARTS. ALL GUIDELINES APPLY TO GSE AS WELL AS FLIGHT HARDWARE UNLESS OTHERWISE NOTED.

* ALWAYS CONSULT YOUR SUPERVISOR AND MANAGER BEFORE INITIATING A CONFIGURATION CHANGE WITH A SUBSTITUTE PART.
* BE SURE THE REPLACEMENT PART IS AS STRONG/SAFE AS THE DESIGNED PART. THIS MAY REQUIRE STRESS ANALYSIS.
* MAKE SURE YOU UNDERSTAND ALL OF THE POTENTIAL EFFECTS OF THE CHANGE. MANY TIMES IT IS EASY TO FOCUS IN ON ONE PROBLEM AND OVERLOOK A POTENTIALLY HAZARDOUS SITUATION WHICH MAY RESULT INDIRECTLY
* ALWAYS WRITE A TYPE 'A' TPS TO FABRICATE ANY PART (INCLUDING GSE) OR TO REPLACE FLIGHT EQUIPMENT WITH A SUBSTITUTE PART. APPROPRIATE MRB ACTION WILL BE REQUIRED FOR ANYTHING LEFT ON THE VEHICLE.
* TAKE ADVANTAGE OF THE LES SHOP FOR MINOR FABRICATION WORK. DO NOT USE SUBSTITUTE PARTS WHICH ARE READILY AVAIBLE BUT SUBSTANDARD.
* USE GOOD ENGINEERING PRACTICE WHEN MAKING A CHANGE. REMEMBER, IT'S YOUR NAME THAT GOES ON THE PAPER.

Mr. WALKER. As you look at this particular bulletin, I would ask the witnesses whether or not you recognize the document, and is it an accurate copy of an engineering awareness bulletin issued by the Lockheed Space Operations Co. to employees working on the SDS at the Kennedy Space Center?

Mr. Sargent.

Mr. SARGENT. No, sir, I don't recognize it at this glance.

Dave, do you?

Mr. OWEN. I don't.

Charlie?

Mr. SARGENT. Mr. Charlie Floyd, the Systems Engineer, does.

Mr. FLOYD. Without having a perfect memory, it appears to be correct. This appears to be a bulletin we issued at that time. There was some follow-up discussion on this subject that we had later and a policy change was made relating to fabrication of flight hardware which had been done in some cases.

Mr. WALKER. This memo is no longer operative?

Mr. FLOYD. Not in its complete context, no.

Mr. WALKER. Let's explore that a little bit and find out just exactly what we have got here.

Are there standard procedures for qualification and certification of man-rated flight hardware?

Mr. SARGENT. Yes, sir, there are.

Mr. WALKER. Do those standard procedures include a comprehensive engineering analysis of new designs and modifications?

Mr. SARGENT. Yes, sir, they do.

Mr. WALKER. Do they include engineering standards for the materials used to ensure strength?

Mr. SARGENT. Yes, I believe they do.

Mr. WALKER. Do they include adequate testing to ensure safety of the crew?

Mr. SARGENT. Yes, sir.

Mr. WALKER. Do they include quality assurance procedures to assure that the parts are built, processed and installed in accordance with all design specifications?

Mr. SARGENT. Yes, sir.

Mr. WALKER. And isn't there usually a requirement that all parts of man-rated systems have a written pedigree that starts with design and flows through design testing, fabrication, quality assurance, testing, and installation?

Mr. SARGENT. I am not certain all parts. I believe that is correct, sir.

Mr. FLOYD. That is generally correct, yes.

Mr. WALKER. That is generally correct?

Mr. FLOYD. Yes; I don't know if it is 100 percent correct. I don't know of any specific examples where it is not correct, either.

Mr. WALKER. So we can assume that that is the case; that you have a written pedigree for each part you use in a man-rated system?

Mr. SARGENT. I believe that is correct.

Mr. WALKER. Well, when you look at this engineering awareness bulletin, it says nothing at all about engineering analysis, design testing, quality assurance, paper trails or safety concerns.

Are those the modifications that were made?

Mr. FLOYD. Well, the changes made to this in a subsequent review after some discussion with specifically the Rockwell Downey development contractor, the LSSC at KSC, and with the NASA Engineering Director, Mr. Lambert, the NASA KSC, a subsequent bulletin was put out that updated this to say that no fabrication of flight components would be done at KSC without prior approval of the NASA Engineering Director, the LSOC Engineering Director, the Rockwell LSSC Engineering Director, and the NASA JSC onsite resident office rep.

Mr. WALKER. When was that memo put out?

Mr. FLOYD. I don't know the exact date.

Mr. WALKER. Approximately when?

Mr. FLOYD. Probably a couple of months after this one.

Mr. WALKER. So we had 2 months where this memo was operative at least?

Mr. FLOYD. Yes.

Mr. WALKER. And during that time we had fabrication taking place and parts under the standards as set forth in this memo?

Mr. FLOYD. If there were any that were attempted, it would have been done under that policy.

Mr. WALKER. Under the policy described in this memo?

Mr. FLOYD. Right.

The fabrication of parts at KSC was virtually nonexistent. There had been a few cases made prior to the SPC transition when it was Rockwell on both ends of the house. Those constituted no problems on the surface.

Once a transition took place and LSS was—excuse me—a LSOP or SPC was responsible for that processing, we did have to go back and reinforce with some of our people that that policy, which might have been allowed in some cases before, was no longer allowed.

Mr. WALKER. Let me ask, first of all, that you provide for the record a copy of the memo that updated this memo.

Mr. FLOYD. OK.

Mr. WALKER. We want that for the record, certainly.

[The information follows:]

ENGINEERING AWARENESS BULLETIN NO. E-9

The attached Engineering Awareness Bulletin No. E-9, dated 8/22/85, was generated as a reminder to SPC Engineering personnel that special considerations were required in those rare cases where fabrication or substitution of parts was dictated to accomplish processing requirements. It was precipitated by discovery that a replacement Ground Support Equipment (GSE) part had been fabricated as a "shop aid" from a drawing generated at KSC.

An Engineering Awareness Bulletin is a SPC internal document used to "highlight or amplify" some aspect of our processing where we have found problems. It does not change any Standard Practice Instructions (SPIs) which dictate the rules and regulations associated with work documentation and work authorization. SPC Engineering is only one of a minimum of three Engineering Approvals required on a Work Authorization Document (WAD). The Engineering Awareness Bulletins are distributed only within Engineering as guidance/reminders to our people; they have no effect on NASA-KSC or SPC Quality Engineering personnel.

The Engineering Awareness Bulletin No. E-9, dated 8/22/85, did amplify the issue of special considerations and the requirement for a Type "A" Test Preparation Sheet (TPS) to authorize and document any fabrications as well as a Material Review Board (MRB) process for approval to use any part that deviated in any way from specifications and drawings on the vehicle. The NASA Design Center (Johnson Space Center or Marshall Space Flight Center) and the Element Development Contractor, as well as NASA-KSC Quality, are represented on the MRB to authorize use of that configuration deviation for flight. Issues are elevated in appropriate management chains for resolution when they occur.

On December 17, 1985, a Revision 1 to Engineering Awareness Bulletin No. E-9 (attached) was issued to much more clearly delineate Engineering actions relative to considerations for use of locally fabricated or substitute parts in the flight vehicle or in Ground Support Equipment (GSE). Since this latter bulletin included special signature requirements, it was coordinated with NASA-KSC and Rockwell Launch Services Support (LSS) Engineering Directors.

The Engineering Awareness Bulletin No. E-9, dated 8/22/85, did not create a void in the system but was actually a positive step in communicating a concern and setting up safeguards (supervisor/manager involvement plus reminder of Type "A" TPS to fabricate) to compensate for what appeared to be a void in the system which SPC inherited from the development contractor at SPC transition.

With the system of multiple organization authorizations and checks and balances on actual work accomplishment, no one can act unilaterally in the Shuttle processing flow.

This set of checks and balances is the basis for a high level of confidence that all paper is closed, that no issues are unresolved and that no "unauthorized" parts are put into the Shuttle.

ATTACHMENT D

Engineering Awareness Bulletin (EAB) No. E-9

Dated 08/22/85

Parts Substitution

The following guidelines are to be followed when replacing standard hardware with substitution parts. All guidelines apply to Ground Support Equipment (GSE) as well as flight hardware unless otherwise noted.

- Always consult your Supervisor or Manager before initiating a configuration change with a substitute part.
- Be sure the replacement part is as strong/safe as the designed part. This may require stress analysis.
- Make sure you understand all of the potential effects of the change. Many times it is easy to focus in on one problem and overlook a potentially hazardous situation which may result indirectly.
- Always write a Type "A" Test Preparation Sheet (TPS) to fabricate any part (including GSE) or to replace flight equipment with a substitute part. Appropriate Material Review Board (MRB) action will be required for anything left on the vehicle.
- Take advantage of the Launch Equipment Support (LES) Shop for minor fabrication work. Do not use substitute parts which are readily available but sub-standard.
- Use good engineering practice when making a change. Remember, it's your name that goes on the paper.

Engineering Awareness Bulletin (EAB) No. E-9

Rev 1

Dated 12/17/85

Parts Fabrication

- This Revision of Engineering Awareness Bulletin E-9 replaces the original bulletin in its entirety.

- The following direction and guidelines shall be adhered to when an Orbiter part(s) requires fabrication.

  1. The unavailability of the required part(s) will impact (slip) the Orbiter Processing Facility (OPF) rollout and/or launch schedule.

  2. Every possible means shall be exercised to obtain the required part through normal Logistics and Launch Services Support Contractor (LSSC) channels.

  3. When the Estimated Delivery Date (EDD) obtained from normal channels does not support Item 1 above, local fabrication will be considered.

  4. Prior to initiating any part(s) fabrication, a Work Authorization Document (WAD) must be generated and the following approval signature obtained:

     - SPC Director of Process Engineering
     - NASA Director of Engineering
     - LSSC Director of Systems Engineering
     - NASA Johnson Space Center (JSC) Resident Office

  5. The manufacturing process used in creating the part must be documented in full and shall include the applicable drawings and specifications. The following shall be included as a minimum:

     - Specification control numbers for raw materials.
     - Detailed control dimensions (dia., wall thickness, etc.).
     - Lot Number traceability.
     - Any critical or special process shall be specified in detail.

  6. The fabricated part will be identified by a unique Order Change Number (OCN) compatible with Orbiter Configuration Verification Accounting System (CVAS). (The number will be obtained from CVAS and recorded on the WAD.)

  7. When approval is given for fabrication, ensure the proper drawing and process specifications are provided to the fabrication shop.

8. A source inspection is mandatory to ensure proper materials are used and the identified processing steps followed.

The proper drawing and process specifications (Item 7 above) and the results of the source inspection (Item 8 above) will be delivered with the part as a portion of the acceptance package.

The above directions and guidelines have been coordinated with and agreed to by NASA and the Launch Services Support Contractor (Rockwell International).

Mr. WALKER. But let me go on with this, because what this memo says—and I think we need to nail down what the modifications were—it doesn't sound to me like the procedures were modified; just who it was reported to. What this memo seems to say is that your technicians can modify or substitute parts of flight hardware or ground support equipment on their own.

Mr. FLOYD. Well, the substitution—first of all, it was engineering, not technicians, and the substitution was different dash numbers of the same basic part number. Like you got a certain part number, and it is a dash 207 versus a dash 208. Is the dash 207 and a dash 208 completely compatible? Usually the drawing tells you.

There were some cases where the issue was left open on the drawings.

Mr. WALKER. But this says nothing about even having to consult the drawings.

Mr. FLOYD. The engineers always consult the drawings. That statement didn't have to be made.

Mr. WALKER. What it says is that you consult your supervisor and your manager before initiating a configuration with a substitute part.

Mr. FLOYD. The reason for consulting them is that responsibility was put on the supervisor and manager to assure that the coordination was done with the development contractor on site to make sure that the drawing was correct, and that there were no issues with that part.

Mr. WALKER. But if somebody followed this particular procedure in detail, they wouldn't even have to consult the drawings. They could be perfectly in order with the procedures outlined and wouldn't even have to consult the drawings.

Mr. FLOYD. That is correct. The listing does not tell them to consult the drawing.

Mr. WALKER. In the memo, it says, be sure the replacement part is as strong and safe as the design part. This may require stress analysis.

Let me ask you: Would you want to fly in a vehicle where a part had been fabricated by a technician to his own design and which had not been subjected to any engineering analysis?

Mr. FLOYD. It was never fabricated to their own design. The few cases where they were fabricated, they were fabricated to the drawing. And the issue that we had with the Rockwell LSS was not our ability to build the part; it was our ability to certify in some cases whether the specific requirements of the drawing were met or not.

Mr. WALKER. It says it may require stress analysis. Is it possible that there are parts installed in orbiters now that had no testing at all?

Mr. FLOYD. No, I don't believe it is.

Mr. WALKER. You don't believe it is?

Mr. FLOYD. I don't believe it is.

Mr. WALKER. You are not positive of that, though?

Mr. FLOYD. I cannot say that——

Mr. WALKER. Under this memo, there could have been parts fabricated and put aboard orbiters that were not subjected to stress tests; is that right?

Mr. FLOYD. There could have been parts fabricated that were not subjected to stress tests.

Mr. WALKER. They could be aboard orbiters, couldn't they?

Mr. FLOYD. I thought that we precluded you from putting them in orbiters later in the memo.

Mr. WALKER. Why are we making parts if we are not putting them in orbiters?

Mr. FLOYD. Sometimes you need them just to be able to move from place to place, because they are not available to provide certain minimum structural or access restrictions.

Mr. WALKER. So you don't think there were any parts fabricated under this memo.

It says flight hardware on here. You don't think there were any parts fabricated that went aboard orbiters?

Mr. FLOYD. That is correct. Read bullet No. 4. Type A TPS, that could do that, is the work authorization document that is approved by the NASA KSC, and the design center contractor, before it is implemented. That is one of the changes that the LSSC contractor supports us in on site.

Mr. WALKER. But our understanding is that you can also do a configuration change with a substitute part as a result of number 1 without doing the No. 4. That is not true?

Mr. FLOYD. Only if it is a PR and you are replacing it with a like unit per the drawing.

Mr. WALKER. What is a PR?

Mr. FLOYD. Problem report. That is, you determine the box to be bad; you are doing the work on the PR because you are returning it to print.

Mr. WALKER. Then you can fabricate that without testing——

Mr. FLOYD. No. You are not fabricating. In the case of substitution, it is not fabricating. It is the dash number on the part.

Mr. WALKER. Well, you talk about a substitute part and then you be sure the replacement part is strong and safe as a design part. The next part—it seems to me that we are talking about a replacement part and not just a substitute. And then we go on to talk about fabricating the replacement parts.

Mr. FLOYD. We don't use substitute parts for the orbiter unless they are built to the same part number. That is done occasionally in the ground support equipment world. My engineers work both in the ground support equipment and the flight hardware. That part of it is referring to the ground support equipment where occasionally, because of availability of hardware, we do have to substitute a functional equivalent valve for another valve that is not available. That is done with concurrence of the design center in that case, which is design engineering, at KSC.

Mr. WALKER. And such parts are never put aboard orbiters?

Mr. FLOYD. That is correct.

Mr. WALKER. And there has never been a case of putting such a part aboard an orbiter?

Mr. FLOYD. I will not say that there has never been a case where a locally manufactured part went aboard an orbiter. I cannot say that.

Mr. WALKER. All of these flight rated systems are supposed to have specific kinds of testing, and so on. Under this memo, it ap-

pears to me as though you could have fabricated parts, put them aboard orbiters, and that they would not be properly tested. And now I am hearing from you that you can't guarantee that that wasn't done according to this memo, and that is my problem.

Mr. FLOYD. What I can say is, if it was done, it was done on the correct type A space TPS with visibility, with full visibility, concurrence of the NASA KSC engineering, the NASA JSC engineering, and the Rockwell Downey engineering.

Mr. WALKER. That is fine. They all looked at it. We all know that they looked at some other things that went wrong down there.

But what I am asking is whether or not any parts got aboard a shuttle that weren't properly tested. And you seem to be saying that we have no guarantees under this memo that that didn't happen.

Mr. FLOYD. This memo, per se, did not guarantee that happened. But this memo, per se, does not establish the entire procedure by which it works. This bulletin was just issued as a precaution to try to cover a hole that we had found in the system due to an incorrect dash number on a certain part getting installed.

Mr. WALKER. Didn't this become general policy then?

Mr. FLOYD. It supplemented general policy.

Mr. WALKER. OK.

And in supplementing general policy, becomes general policy; correct?

Mr. FLOYD. Except you cannot make a configuration change without all the right levels of approval. It did not change that policy.

Mr. WALKER. It didn't change the policy of the sign-offs. The problem is, though, that you are specifying here some things that allow fabrication work to be done. As we have gone around the circle here, I get the impression that we could in fact have fabrication of parts being done that could get aboard orbiters, and therefore be parts aboard orbiters that haven't been properly qualified and tested. And you seem to agree that that might have happened?

Mr. FLOYD. I don't believe it happened. I cannot unequivocably say that it didn't happen, either, with SPC or before SPC. I don't know for a fact that every part itself undergoes individual testing. That is your data.

Mr. ROE. Will the gentleman yield?

Mr. WALKER. Be glad to yield to the gentleman.

Mr. ROE. What we are trying to do is come to—and eventually we will get there, believe me—to unravel the whole situation. Fundamentally, people are coming back and saying you had the O-ring problem, the joint, the seal, the whole thing. However, there are 723 criticality-1 items and a whole slew of items 1-R, et cetera.

The concern is the safety. The safety to a part goes to testing, to a procedure to test, a redundancy: Do we have a duplicate system? Any one of the 700 parts, if they fail, purportedly could cause a catastrophic accident.

Isn't that true? I think the gentleman is making the point someplace it has got to be nailed down. Who is responsible? Who makes that decision? Is it made at the highest level of NASA? If each one of these parts—if it is criticality-1, who makes that decision?

We didn't get the answer out. We said yes, Mr. Owen, there have been some criticality item 1's that have been cannibalized. How

many? 1? 2? 15? 18? Is there an inventory on the three orbiters that would tell us that information? Does somebody along the line have the right to come back under this particular thought process and this memorandum and fabricate a part? Who does that? Who is in charge? Who has got the final word when any one of the criticality-1 items or the others could create a catastrophic accident?

That is the concern of the committee.

Mr. FLOYD. To us, that authority is NASA JSC and the Rockwell LSSC contractor at KSC, in coordination with Rockwell Downey for the orbiter. For the other vehicles, it is equivalent.

Mr. ROE. We are coming back, and we are saying to NASA that someplace along the line you are fundamentally basically responsible.

Mr. Director, you are the director of the system. You have people appointed. You are then responsible under him. Beyond that, the contractors are hired guns, is where we are trying to come from, and we are not trying to nail you down today. We are trying to say what do we do? Business as usual?

That is what the debate is about: Two years down the line, how long is it going to be? Can we hold qualified personnel? What do we do? Is the spirit of the organization there? This is what we are looking at, not just one particular part, not just one O-ring. We have got to go and fight for the fourth orbiter. Can we do it with three?

You told me something this morning that I didn't know in the discussion in the conference last night. Can we fly without three, or do we have to have four? What is the magic of four? Can we do it with three?

Now, I have got to go back and find out of the three that we have, how many parts have been cannibalized, who took the parts out, where are the parts, is there a solid inventory, was it taken out, was it fabricated from nickel alloys or from something else, who decided it, where do we make the decision from, who is responsible, who is in charge. This is what this hearing is about.

Pardon my enthusiasm, but it has been four weeks, and one is bound to arrive at that point. The question the gentleman is asking—and if you don't know, I respect you for saying "I am not sure"—but the question remains: Could someone under this particular memoranda have gone in and done a part change that you don't know something about? Who is in charge of it? Does he have a right to do that?

Mr. FLOYD. He doesn't have the right to do that if he follows the paperwork system. I personally cannot attest that every step in the paperwork system was followed on every procedure that was run. I believe it to be the case. I trust the people who work for us, and we have good open reporting, and I believe that I would know about it if that happened.

Mr. WALKER. Let me make the point that this is a part substitution bulletin that says, the following guidelines are to be followed when replacing standard hardware with substitution parts. Now, my point is that someone could follow every one of those procedures and think that he did exactly the right thing, and it appears to me—and having done so the bottom line is—he could have fabri-

cated a part that has not been properly tested and put aboard an orbiter.

Did NASA sign off on this bulletin?

Mr. FLOYD. NASA does not concur on that bulletin, because that bulletin does not affect how NASA operates. NASA has their own set of policies and how they check. We try to stay closely coordinated with NASA so that we don't have any inconsistencies.

Mr. WALKER. You said earlier that NASA is responsible, and now you say there is a bulletin out that NASA didn't concur with, which could result in changes to NASA hardware.

Mr. FLOYD. At the time we wrote this, we felt that this was not a violation to the policy we had with NASA.

Mr. WALKER. But how does it affect SPC operations?

Mr. FLOYD. We need to look at bullet 4. It says if you use a vehicle, appropriate MRB action will be required for anything that is left on the vehicle. MRB is Material Review Board, and that is the standard procedure that is used throughout the shuttle program for authorization of a vehicle to fly with a part that is not per the drawing.

Mr. WALKER. But you can make a configuration change under this memo?

Mr. FLOYD. I don't believe you can make it because the MRB approval is a prerequisite to closing the paper that makes that change. The MRB approval goes on the actual paper that does the work.

Mr. KENNEDY. Let me try to add a little light, perhaps.

Mr. ROE. We have to vote on second call, so suppose we recess for a minute and we will be returning immediately.

[Recess.]

Mr. ROE. The committee will reconvene.

We are hearing from our good colleague from Pennsylvania, Mr. Walker.

Mr. WALKER. Thank you, Mr. Chairman. You have been more than generous with the time.

Let me say that based upon what occurred, I guess the thing that concerns me is the fact that evidently this was an operative memo for some time and has now been changed, and we will be interested in seeing the changes that have taken place.

Second, if I understood correctly, there is a difference in guidelines between what you do and what NASA does. The whole point is that, as the Rogers Commission told us, reliance on paper trails can be a fatal mistake. If you have different guidelines governing different people who have supervisory responsibility in this problem, those paper trails then tend to become less and less useful.

So, I am concerned about what this particular document may represent in terms of a breakdown of the system that supposedly assures quality and assures things are properly tested. I will look forward to reviewing the information that, as you have pointed out, is the follow-up information.

Thank you.

Mr. ROE. I thank the gentleman.

What we are trying to get across here is the concern of the committee in the area of the spare parts issue, the concern of the committee as it relates to the cannibalization of parts and pieces from

the three orbiters that we have. It would be, I would think, constructive if you have the data to be able to provide the committee supplementary information as to your knowledge of how many parts have been taken from each one of the three orbiters, and what does that inventory indicate; and, is that cross-checked totally with NASA. That is an important gap to close.

It seems to me when we are debating the issue of the whole program, never mind your contract, the debate now is: Can we fly with three? Do we need four? Should we be doing five, 12 flights a year, 18 flights a year? What do we do? That is the decision that this committee is going to have to fortify and report to the Congress itself.

Having said that, this data that you are about to give us can be extremely helpful in making that decision, because I think the flying of the orbiters has to do with what we have and what we don't have in spare parts.

Thank you for your valid testimony. It has been of great help to us. We appreciate your taking your time to join us this morning.

Our next witness is James R. Dubay, president and general manager of EG&G, Florida, Inc.

Is Mr. Kerr going to be—we also have with us Dr. Donald Kerr, senior vice president.

Mr. Dubay, welcome to our committee hearing this morning. We have a copy of your testimony. Please proceed.

STATEMENT OF JAMES R. DUBAY, PRESIDENT AND GENERAL MANAGER, EG&G FLORIDA, INC., ACCOMPANIED BY DONALD KERR, SENIOR VICE PRESIDENT, EG&G, INC.

Mr. Dubay. Thank you, Mr. Chairman and distinguished members of the subcommittee.

I am James Dubay, and I am the general manager of EG&G, Inc. You have before you a summary fact sheet of our contract which outlines the responsibilities which I believe is fairly straightforward. It is totally an institutional and launch support services contract effort, and is similar to the SPC in that it parallels the NASA concept of consolidation. In this case, we consolidated 14 operating service and support contracts into one.

I won't propose to read the summary fact sheet, since I believe it is fairly straightforward, and would defer to the committee if there are any specific questions on our aspect of responsibility.

[The prepared statement of Mr. Dubay follows:]

STATEMENT SUBMITTED FOR THE RECORD

COMMITTEE ON SCIENCE AND TECHNOLOGY

UNITED STATES HOUSE OF REPRESENTATIVES

INVESTIGATION OF

THE CHALLENGER ACCIDENT

July 16, 1986

Mr. James R. Dubay
President & General Manager
EG&G Florida, Inc.

INTRODUCTION

EG&G, Florida, a division of EG&G, Inc., was selected by NASA in November, 1982, to assume the responsibilities of the Base Operations Contract (BOC) at the John F.Kennedy Space Center [KSC]. EG&G performed contract phase-in during December, 1982, and accepted full operating responsibilities on January 1, 1983.

CONTRACT SCOPE

The Base Operations Contract is primarily an institutional support services contract for NASA and the user community at KSC. The contract is divided into six major areas:

Management - Procurement, Training, Safety, Reliability and Quality Assurance, Planning, Scheduling and Work Control, Maintenance Management, Logistics Management, Configuration Management, and Sustaining Engineering.

Utilities - Power, Lighting, Heating, Ventliating, Air Conditioning, Water, Sewer and Administrative Communications.

Facilities - Buildings, Structures, Roads, Grounds and Heavy Equipment.

Administrative Services - Mail, Library, Printing, Micrographics, Supply, Transportation and Janitorial.

Technical Operations - Computer Operations, Calibration and Standards, Propellant and Life Support, Nondestructive Evaluation, Sampling and Analysis, and Hazardous Waste Management.

Health and Protective Services - Occupational Medicine, Environmental Health, Fire and Security.

As of July 1, 1986, EG&G and its subcontractors had 2189 personnel in direct support of these functions.

SUPPORT FUNCTIONS

EG&G Florida provides a variety of support services to NASA, Shuttle processing contractors, Cargo contractors, the Air Force, and other tenants and users at KSC. The services are provided in different ways to different users, as outlined below.

Routine Recurring Services - These services include such things as mail delivery, supply, library, janitorial, and landscaping.

Operations and Maintenance Services - These services generally include the operation and maintenance of the real property assigned to the BOC which are the utilities, building, structures, roads and grounds.

Special Work Tasks - These services are varied and generally are received by a written support request from the user. They include moving furniture, shop support, transportation requirements, printing computer services, calibrations and non-destructive evaluation.

Protective Services - EG&G provides the fire fighting and fire prevention/protection work, security, investigative and law enforcement functions at KSC.

Mission Support Requirements - These support services are provided in support of the KSC integrated control schedule and payload operations support schedule. These services include providing commodities used for propellant loading, life support equipment, emergency medical services, fire protection and security.

DONALD M. KERR

Donald M. Kerr, is a Senior Vice President, of EG&G, Inc., Wellesley, Massachusetts, and its Government Systems and Service Group Executive.

He is responsible for long-term engineering and site-management programs, conducted under government contracts, which support national defense and security; the nation's manned space program; and nuclear, fossil, and alternative energy research and development.

These activities comprise approximately two-thirds of EG&G's scope of operations, employing over 17,000 people at various locations around the U.S., including NASA's Kennedy Space Center, DOE's Nevada Test Site and Idaho National Engineering Laboratory.

Prior to joining EG&G, Inc. in 1985, Dr. Kerr served as Director of the University of California's Los Alamos National Laboratory from 1979 through 1985. He was also employed at Los Alamos from 1966 until 1976 conducting and leading research in high altitude weapons effects, nuclear test detection, weapons diagnostics, ionospheric physics, and alternative energy programs.

From 1976 until 1979, Dr. Kerr served in the U. S. Department of Energy, first in Las Vegas as Deputy Manager of the DOE Nevada Operations Office and, subsequently, in Washington, D.C., as Deputy Assistant Secretary and Acting Assistant Secretary for Defense Programs and, later, for Energy Technology.

A native of Philadelphia, Dr. Kerr received his Bachelor's degree in Electrical Engineering and his Master's from Cornell University. He earned a Ph.D. in Plasma Physics and Microwave Electronics from the same institution in 1966. He serves on the Joint Strategic Target Planning Staff, Scientific Advisory Group; the Cornell University Engineering Alumni Council; and is a Member of the Corporation of the Charles Stark Draper Laboratory and a Fellow of the AAAS.

Dr. Kerr is married to the former Alison R. Kyle of Lakewood, Ohio, and lives in Wellesley Hills, Massachusetts.

64-548 O—86——6

Kennedy Space Center Base Operations Contract: EG&G Florida, Inc.

Mr. James R. Dubay, President and General Manager

Contract No.: NAS10-10600
Awarded: January 1, 1983 (Planned 10 Year Period)
Contract Value: 1983 through 1986, $428,000,000
Contract Type: Cost-Plus-Incentive/Award Fee
Current Staffing: 2,270

MISSION

EG&G is responsible for management, operation, maintenance and engineering for KSC utilities, (power and lighting, heating and air conditioning, water and sewage, administrative communications): facilities, (buildings and structures, roads, grounds and heavy equipment); administrative services, (mail, library, printing and micrographics, graphics, supply and transportation, janitorial); technical operations, (computers and data processing, calibration and standards, propellants and life support, non-destructive evaluation, sampling and analysis); and health and protective services, (occupational medicine and environmental health, fire and security).

In the accomplishment of the above EG&G is responsible for required procurement, resource management, training, safety, reliability and quality assurance, planning, scheduling and work control, configuration management and sustaining engineering.

ISSUE

The main question we want to explore is the dividing line between the Base Operation Contract (BOC) and the Shuttle Processing Contract (SPC). For example, who is responsible for the large cranes in the Vehicle Assembly Building. One of these cranes was malfunctioning at the time of the November, 1985 SRM handling ring mishap. Similarly, EG&G is responsible for propellants under the BOC but the SPC contractor (Lockheed) loads the propellants into the Shuttle. Again, where is the line of responsibility.

QUESTIONS

1. (a) Who has responsibility for the cranes used in the VAB to stack the SRBs and make the Shuttle elements, BOC or SPC?

   (b) How is this responsibility divided? If the BOC is responsible for the building are the cranes part of the building?

   (c) Are there ever questions of responsibility for problems at the interface between contractors?

2. Where does the BOC responsibility for propellants end and the SPC responsibility begin?

3. Have you ever been responsible in any way for delays? For example

·has the SPC ever had to wait because some facility you were responsible for needed repairs?

4. Have there ever been any conflicts between your organization and other support contractors at KSC? (e.g. Lockheed) How have they been resolved?

5. What is your involvement in the launch activities? Are you represented on the Mission Management Team for example?

6. What are your resonsibilities in Logistics Management? Are you involved with defining spares requirements, procuring spares, etc.? Please explain.

7. What is your role in SR&QA?

Mr. ROE. Basically—if the gentleman would yield, basically as we look at your testimony, which I reviewed, you are really the infrastructure organization of the whole operation at Kennedy.

Would that be a fair commentary? I mean, you are handling the procurement, training, safety, reliability, quality assurance, planning schedule, work control, maintenance, management, logistics, and so forth covering all the utilities at the base, the facilities, the buildings and structures and grounds, heavy equipment, administrative services. So, it is the whole support infrastructure of the Kennedy Space Center.

Mr. DUBAY. That is correct, Mr. Chairman.

Mr. ROE. OK.

What we want to try to determine, which I think would be helpful for our overall program, is that the main issue as we see it is we want to explore the dividing line between the base operation contract and the shuttle processing contract. For example, who is responsible for the large cranes in the vehicle assembly building? Purportedly, one of these cranes was malfunctioning at the time of the November 1, 1985 SRM handling of the ring mishap.

Similarly, EG&G is responsible for propellants under the BOC, but the SPC contractor, Lockheed, loads the propellants into the shuttle so there is a relationship. It is not just the simplicity of the point of view in relative value of the infrastructure such as power and light and utilities and so forth. You have an integral relationship on certain parts.

Mr. DUBAY. Yes, Mr. Chairman, we do.

Basically, the concept is to put all of the institutional and the base support services into one contract, and all of the support mechanisms which are directly supportable to the shuttle in the hands of the SPC contractor. So that, in fact, both in the propellants area and in your utilities, primary power, things like that, we take the power to an interface point, at which the SPC contractor takes over and is responsible for those systems as they impact or interface or support his activity, which are directly relatable to the shuttle.

We go to a point, and it is understood between us that beyond that point the SPC contractor has that responsibility.

Mr. ROE. The same thing with propellants, too?

Mr. DUBAY. Yes.

Mr. ROE. In other words, you bring basic materials to a given point and then the responsibility is turned over to the SPC and they decide, as far as servicing the vehicles is concerned?

Mr. DUBAY. That is right. They call on us for the quantities of those propellants that they need. We deliver them through the pipeline to a distinct valve at which point they take over. We, as a launch support contractor, respond to their requirements.

Mr. ROE. How do you divide the responsibility on the cranes?

Mr. DUBAY. In that regard, the installed equipment, which is directly related to the shuttle, is an SPC responsibility. We do not have responsibility nor do we operate equipment which directly impacts on the flight vehicle.

Mr. ROE. Do you provide the cranes yourself? Is that provided through you or is that a separate contract?

Mr. DUBAY. No; that is part of the SPC facility inventory.

Mr. ROE. The gentleman from Pennsylvania.

Mr. WALKER. Thank you, Mr. Chairman.

What modifications in your facilities have had to be made as a result of what we have found out thus far about *Challenger*?

Mr. DUBAY. We have made no modifications to this point in time, Congressman. We are, along with all the other contractors in the system, currently validating all of our systems, all of our procedures, refining and certifying single point failure analysis, just revalidating everything that is in the system.

Mr. WALKER. Do you anticipate you are going to have to make changes in the facilities?

Mr. DUBAY. It wouldn't appear at this time that there are any mandatory changes that have come to light. Obviously, with a view to increased safety and quality, there would be much more emphasis put on those things, and I would expect greater focus, sharpened procedures, all along the line.

Mr. WALKER. Do you have any responsibility, though, for the launch pads?

Mr. DUBAY. We have installed equipment, transformers, and that type of thing on the towers that we are responsible for.

Mr. WALKER. If we have to put heating equipment on the launch pads, would that be your responsibility?

Mr. DUBAY. That would depend on the nature of the equipment. We may well provide the power, the generators. However, anything that goes directly to the bird I am sure would be an SPC responsibility. We would provide the power to an interface point.

Mr. WALKER. For example, if we were to put heating equipment on the launch tower itself to essentially keep the SRB's warm in cold weather, would that be your responsibility, or would that be SPC?

Mr. DUBAY. It could well be ours. As a piece of installed operating equipment on the tower, it is likely that we would have a responsibility there, yes.

Mr. WALKER. It would appear as though that is one thing that flows from the Rogers Commission report, that that may be a modification that would have to be made.

Do you see other kinds of things in the Rogers Commission report that are going to require you to make modifications? If I understood your answer before, you do not see those.

Mr. DUBAY. We do not at this time.

Mr. WALKER. So, you do not see any major expenditures having to be made by NASA in order to fulfill your needs as a contractor post-*Challenger*?

Mr. DUBAY. No, sir.

Mr. WALKER. Do you have any idea what kind of costs would be involved in modifying the tower, for instance, to provide heating?

Mr. DUBAY. I would have no idea at this time, sir.

Mr. WALKER. Are there any security improvements that are under consideration at the Cape?

Mr. DUBAY. Security is an aspect that is being enhanced. We are responsible primarily for security. However, I think that current installation of electronic security systems that is being done will basically suffice. Systems will be expanded, no doubt. But that is a normal evolutionary process.

Mr. WALKER. You do not see the need for considerable new expenditures in that particular aspect of your activities?

Mr. DUBAY. No, sir, not at this time.

Mr. WALKER. How frequently does the SPC have to alter planned work or wait while EG&G does things?

Mr. DUBAY. Hopefully not at all, sir. We believe we are very responsive. There are obviously times when we have to scramble to meet a requirement, but I would say the net impact on a system in terms of requirements that we are responsible for is virtually none.

Mr. WALKER. Are there any points where we had delays in the shuttle launches that it came about as a result of activities that you had underway that delayed the SPC work?

Mr. DUBAY. No, sir, not to my knowledge.

Mr. WALKER. Not to your knowledge.

Thank you, Mr. Chairman.

Mr. ROE. The Chair recognizes the distinguished gentleman from Florida.

Mr. LEWIS. Thank you, Mr. Chairman.

Did you say that you did or did not have responsibility for the pad?

Mr. DUBAY. It is a combination, sir. We have the—the interfaces at Kennedy are based on a division of installed systems or equipment, and that is—that simply depends on the configuration of the equipment, the remoteness of the equipment from the shuttle proper. We are responsible for security on the pad. We have installed equipment and systems on the pad and we provide all of the environmental health requirements for detecting hazardous atmospheres and clearing areas for work so we are definitely on the pad.

Mr. LEWIS. Is the fire water your responsibility?

Mr. DUBAY. The fire water system is an installed piece of equipment which we own most of, yes, sir.

Mr. LEWIS. It is my understanding that on January 28, the fire water sprays were turned on in order to protect against the temperatures. Is that true?

Mr. DUBAY. Yes, sir; they were.

Mr. LEWIS. And the drain was plugged on the pad so that the water couldn't run off. Is that true?

Mr. DUBAY. I believe that is true.

Mr. LEWIS. Was that your responsibility?

Mr. DUBAY. In terms of the actual system and equipment at that level, no, sir. We were not a part of that complement of people on the pad at that time. That was an unforeseen weather situation which simply got by everyone.

Mr. LEWIS. Are you an incentive fee contractor?

Mr. DUBAY. It is a combination, award and incentive fee; yes, sir.

Mr. LEWIS. The gentleman from Pennsylvania had asked you—have there been any delays where you would have and the SPC have to work overtime?

Mr. DUBAY. Not to my knowledge, no, sir.

Mr. LEWIS. If there would be, how would you work those out?

Mr. DUBAY. It would be like any other delay in the countdown sequence. Everybody responds to it regardless of the source of the responsibility or the nature of the breakdown. It is a critical point beyond which the system cannot proceed and everybody is impact-

ed in accordance with their involvement. We simply—it would cause cost impact and time delay to everyone involved. Every contractor would suffer.

Mr. LEWIS. Are you satisfied that EG&G has a cozy family operation and the SPC is satisfied and that NASA right through the line? Do you have a close-knit family operation that we can launch vehicles and——

Mr. DUBAY. From our viewpoint, we believe we have made great progress in solidifying and identifying all of the interfaces that have to be critically defined and agreed to. The operating relationship between us and the SPC, as a matter of fact, has been very, very close, very productive and very harmonious.

Mr. LEWIS. How about with NASA? Do you feel the same way about that?

Mr. DUBAY. Yes, sir; the same way.

Mr. LEWIS. Thank you, Mr. Chairman. I have no further questions.

Mr. ROE. I thank the gentleman.

I think there are no further questions. You are getting off rather easy.

Mr. DUBAY. That is probably an indication of our remoteness from the investigation itself.

Mr. ROE. But it is part of the system and interfacing that is important to us so we appreciate your being with us this morning.

Our next witness is Mr. George R. Faenza, vice president and general manager, McDonnell Douglas Astronautics Co.

We want to welcome Mr. Faenza. We have your testimony, but I think you might want to present it because in looking it over, I think there are good points you are making.

STATEMENT OF GEORGE R. FAENZA, VICE PRESIDENT AND GENERAL MANAGER, McDONNELL DOUGLAS ASTRONAUTICS CO.

Mr. FAENZA. Thank you, Mr. Chairman and committee members.

I will summarize and there are points I would like to make.

I am George Faenza, the vice president and general manager of the McDonnell Douglas Astronautics Co., Kennedy Space Center Division.

When we started as we interfaced with the shuttle that was in 1977 when we were selected to be NASA's contractor for space lab integration and operations and maintenance. We have an interface as an entity relative to the space lab hardware with the SPC as well as with the BOC, Mr. Dubay and his organization support us and we in turn support the SPC.

I will comment later on that.

We are responsible for some mission flight activities and we do have the total responsibility for deintegration once the orbiter comes back to the OPF.

We became further involved with the shuttle operations when we were selected to be NASA-KSC's contractor for a contract called the interim cargo operations activity.

This is where we host the commercial, Government and other users of the shuttle.

Specifically, we are required to process the STS customer's hardware through the payload facilities which are separate and distinct from the shuttle payload facilities except for the payload facility change-out room, which is on the launch pad.

We verify that their interface will be compatible with each other especially when multiple elements are manifested as one cargo and with the shuttle when the payload is integrated with the orbiter.

I make a comment on skill mix. I think it is of interest to the committee.

We include all of the engineering, logistics, material, assembly and test, safety, reliability, quality assurance, technical operations, planning and scheduling, and obviously the attendant management to do this job.

We are responsible for all payload off-line—I wanted to express a point here again stating off-line as opposed to the on-line operations for shuttle. We have facilities there so designated for payload operations, including the handling and testing of payload elements as they are prepared for integration with each other and with the orbiter.

Specifically, we prepare procedures and software and accomplish testing to satisfy the STS customer requirements and verify that their systems are working as designed prior to integration with the orbiter.

This requires that our personnel work closely with NASA and the customer throughout the mission flow to ensure that all customer needs are accommodated.

Of particular importance is our capability to prepare payloads for flight without impacting the on-line shuttle operations.

Through the utilization of the cargo integration test equipment located in the vertical processing facility and the operations and check-out building, we can assure that the payload and orbiter interfaces will meet according to specification.

We are able to test this interface early in the flow in the off-line facility while the orbiter is being readied for flight. This capability has allowed us to work with NASA at KSC, the customer, the shuttle processing contractor, and the other centers involved for resolving any problems encountered without impact to shuttle operations.

For mission 51-L, we processed the TDRS-B through the vertical processing facility and we supported NASA-KSC as they prepared Spartan Halley in the operations and check-out building. We then transported Spartan Halley to the orbiter processing facility where we supported NASA and the shuttle processing contractor during the installation and integration of the payload into the orbiter.

Simultaneous with the Spartan Halley activities we were verifying TDRS-B interfaces and systems at the vertical processing facility in preparation for TDRS-B transport to the launch pad. The TDRS-B was transported to the pad and inserted into the payload change-out room in preparation for installation in the orbiter. After orbiter arrival, the TDRS-B was inserted into the orbiter by the shuttle processing contractor with our support and we then supported the integrated testing of the total payload complement conducted by NASA and the shuttle processing contractor. Our

payload test team members, both MDAC and NASA, were in support of the 51-L countdown and launch.

To summarize that, Mr. Chairman, there are several payload contractor interfaces with the shuttle processing contractor. At the beginning of a mission we provide support to the shuttle processing contractor's planning and scheduling meetings to ensure timely response to their schedule milestones and we continue this involvement throughout the mission flow.

Our major interface with shuttle occurs when we support the shuttle processing contractor during installation of the payload into the orbiter, either at the orbiter processing facility or at the launch pad. This interface includes complete support to the shuttle processing contractor for installation and throughout integrated testing, culminating with countdown to launch.

As the payload contractor for NASA-KSC for the spacelab and interim cargo operations contracts, I believe the concept we are working to is a good one and it is working well from the payload contractor viewpoint.

The roles and responsibilities are defined and understood. As a complement to the NASA shuttle and cargo management agreements relating to their roles and responsibilities, the shuttle processing contractor and I have a signed memorandum of understanding and agreement which we operate on.

This memorandum of understanding and agreement is also agreed to and signed by our respective NASA directors. We are performing within this understanding and to date it has proven to be very successful.

Our experience base is established through the safe and successful operations for 51 major payloads since the flight of STS-2. The concept of off-line and on-line facilities and operations managed and operated by a Government/contractor team which has responsibility for performance and is knowledgeable and experienced in this type of work has provided the checks and balances needed to ensure safe and effective processing.

At this time, Mr. Chairman, if you so like, I would be happy to answer any questions.

[The prepared statement of Mr. Faenza follows:]

STATEMENT TO THE COMMITTEE ON SCIENCE AND TECHNOLOGY

JULY 16, 1986

George R. Faenza
Vice President-General Manager
McDonnell Douglas Astronautics Company
Kennedy Space Center Division

16 July 1986

Mr. Chairman, Committee Members

I am George Faenza, the Vice President and General Manager of the McDonnell Douglas Astronautics Company - Kennedy Space Center Division. (1)

I am pleased to be here to present testimony related to the role of the payload processor at the Kennedy Space Center in support of shuttle operations.

By way of setting the stage for the committee, I would like to establish some data points. The role of this division at Kennedy Space Center within the corporation is to provide Payload Ground Operations support to NASA and the Department of Defense in support of the Shuttle program. McDonnell Douglas Astronautics Company first became involved in the payload side of the Shuttle at KSC in March 1977. This is when we were selected to be NASA KSC's operations and maintenance contractor for the European Spacelab hardware, software and ground support equipment. This contract requires that we perform all hands-on processing tasks for Spacelab as we prepare the system for flight. We perform our work tasks from receipt of Spacelab equipment hardware through Spacelab-to-Orbiter integration, through countdown, flight operations and landing.

We are responsible to perform some mission support during flight operations as well as all deintegration tasks for Spacelab after the shuttle lands and returns to the Orbiter Processing Facility. The majority of our work for this contract is performed in the Operations and Checkout building. This building houses two Spacelab test stands, a high fidelity electrical and mechanical Orbiter simulator identified as Cargo Integration Test Equipment which we operate and a Level IV integration area managed and operated by NASA.

NOTE: This building is where the Spartan Halley payload was processed by NASA prior to insertion into the Orbiter for 51-L.

We became further involved with the Shuttle operations when we were selected to be NASA KSC's Interim Cargo Operations contractor in April 1979. This contract requires that we perform in a host role to the commercial, government, and other users of Shuttle. Specifically we are required to process the STS customer's hardware through the payload facilities, verify that their interfaces will be compatible with each other (when multiple elements are manifested as one cargo) and with the Shuttle when the payload is integrated with the Orbiter. The majority of our work for this contract is performed in the Vertical Processing Facility. This facility has two vertical test cells which are essentially twin Cargo Integration Test Equipment stands which we operate for processing payloads.

A third element I manage is our Shuttle Payload Operations Contract in support of the Department of Defense. Our efforts on this contract are similar to those we perform on the NASA Interim Cargo Operations contract.

To perform the work described a staff of approximately 1000 was on our payroll prior to the Shuttle accident. Today we are staffed at approximately 875 with a little over 700 being dedicated to our NASA Spacelab and Interim Cargo Operations contracts.

Our skill mix for this effort includes engineering, logistics, material, assembly and test, safety, reliability, quality assurance, technical operations, planning and scheduling, and the attendant management.

Our responsibilities as related to integrating payload processing into Shuttle operations, in particular for a mission similar to 51-L, are as follows:

We operate and maintain the Vertical Processing Facility which is where the Tracking and Data Relay Satellite-B (TDRS-B) was integrated and tested prior to installation into the Orbiter.

(4)

We are responsible for all payload off-line (this meaning off-line to shuttle operations) activities, including handling and testing of payload elements as they are prepared for integration with each other and with the Orbiter. Specifically, we prepare procedures and software and accomplish testing to satisfy the STS customer requirements and verify that their systems are working as designed prior to integration with the Orbiter. This requires that our personnel work closely with NASA and the customer throughout the mission flow to ensure that all customer needs are accommodated. Of particular importance is our capability to prepare payloads for flight without impacting the on-line Shuttle operations. Through the utilization of the Cargo Integration Test Equipment located in the Vertical Processing Facility and the Operations and Checkout Building, we can assure that the payload and Orbiter interfaces will meet according to specification. We are able to test this interface early in the flow in the off-line facility while the Orbiter is being readied for flight. This capability has allowed us to work with NASA at KSC, the customer, the Shuttle Processing Contractor, and the other centers involved for resolving any problems encountered without impact to Shuttle Operations.

For Mission 51-L we processed the TDRS-B through the Vertical Processing Facility and we supported NASA KSC as they prepared Spartan Halley in the Operations and Checkout building. We then transported Spartan Halley to the Orbiter Processing Facility where we supported NASA and the Shuttle Processing Contractor during the installation and integration of the payload into the Orbiter. Simultaneous with the Spartan Halley activities we were verifying TDRS-B interfaces and systems at the Vertical Processing Facility in preparation for TDRS-B transport to the launch pad. The TDRS-B was transported to the pad and inserted into the Payload changeout room in preparation for installation in the Orbiter. After Orbiter arrival the TDRS-B was inserted into the Orbiter by the Shuttle Processing Contractor with our support and we then supported the integrated

testing of the total payload complement conducted by NASA and the Shuttle Processing Contractor. Our payload test team members, both MDAC and NASA, were in support of the 51-L countdown and launch. (5)

A summary of the payload processing activities as they relate to shuttle operations is as follows:

There are several payload contractor interfaces with the Shuttle Processing Contractor. At the beginning of a mission we provide support to the Shuttle Processing Contractor's planning and scheduling meetings to ensure timely response to their schedule milestones and we continue this involvement throughout the mission flow. Our major interface with Shuttle occurs when we support the Shuttle Processing Contractor during installation of the payload into the Orbiter, either at the Orbiter Processing Facility or at the launch pad. This interface includes complete support to the Shuttle Processing Contractor for installation and throughout integrated testing, culminating with countdown to launch.

As the payload contractor for NASA KSC for the Spacelab and Interim Cargo Operations contracts I believe the concept we are working to is a good one and it is working well from the payload contractor viewpoint. The roles and responsibilities are defined and understood. As a complement to the NASA Shuttle and Cargo Management agreements relating to their roles and responsibilities, the Shuttle Processing Contractor and I have a signed Memorandum of Understanding and Agreement which we operate to. This Memorandum of Understanding and Agreement is also agreed to and signed by our respective NASA directors. We are performing within this understanding and to date it has proven to be very successful.

Our experience base is established through the safe and successful operations for 51 major payloads since the flight of STS-2. The concept of off-line and on-line facilities and operations managed and operated by a Government/ Contractor team which has responsibility for performance and is knowledgeable and experienced in this type of work has provided the checks and balances needed to ensure safe and effective processing. (6)

McDonnell Douglas Astronautics

Contract # NAS 8-32350, KSC-1

Date Awarded: 3/10/77

Period of Performance thru: 9/30/86

Contract Type: CPAF (Cost Plus Award Fee)

Contract Value:	FY83:	$19.6 million
	FY84:	27.1 "
	FY85:	41.5 "
	FY86:	28.5 "

Current Staffing: Approximately 355

Mr. ROE. Thank you.

Just for clarity, in your testimony you refer to the numerical numbers of people.

Mr. FAENZA. Yes, sir.

Mr. ROE. 875; right?

Mr. FAENZA. Yes, 875 on my payroll today.

Mr. ROE. NASA has reported to the committee that you only have 355 staff at present. Is that correct?

Mr. FAENZA. I believe that is in error.

Mr. ROE. That is in error?

Mr. FAENZA. Yes, sir. This figure I am giving here is—the 700 that I point to specifically, approximately 700 is what I have in support of NASA programs.

Mr. ROE. That is for clarity.

The other point I was making, a point that you made at the tail end, which was an important one, you have had successful from your responsibilities point of view 51 major payloads since the flight of the STS-2, so you have had a pretty good record as far as we understand.

Mr. FAENZA. Yes, sir.

Mr. ROE. The gentleman from Pennsylvania.

Mr. WALKER. Thank you, Mr. Chairman.

Did you have transitional problems when the SPC contract moved from one contractor to another?

Mr. FAENZA. We had some transition problems in that we had already established a MOU with Rockwell and we had to reestablish it with Lockheed, but we worked that and we ended up signing that agreement with Dave Owen and myself and the other folks, but that was the major understanding of transition responsibility and signature.

Mr. WALKER. There have been no problems in terms of the work patterns or the—providing appropriate quality assurance, all of those kinds of things? The interface integration was fairly easily taken care of once you got your memorandums——

Mr. FAENZA. For a job of this size, with that major transition, I must say it was very smooth. We had minor situations, but that was it.

Mr. WALKER. If you had to point to the major interface problem that you have in working with a vehicle, what would it be?

Mr. FAENZA. In working with the orbiter?

Mr. WALKER. Yes.

Mr. FAENZA. The way we transition, my organization has total responsibility of payload with the NASA payload management group, until we bring the payload to the OPF or to the PCR where we then transfer while the payload is on the hook.

For example, out of the canister, we hook it up and transfer and support them. As related to interface problems at that time based on where we are in the maturity of the SPC, that is the only place we could have anything. If there was any other conflict, it would be generally in how we get our requirements established, but once they are established, then we all work to them and that comes through scheduling meetings and communications at the start when a mission is identified.

Mr. WALKER. It is fascinating as the chairman has just pointed out that NASA has a figure of 355 employees, whereas you have a figure of 875 employees. Do you have any idea where the 355 figure might come from?

Mr. FAENZA. No, sir, I do not, and I am surprised at that.

Mr. WALKER. A discrepancy of 500 employees is somewhat meaningful.

Mr. FAENZA. Let me make sure I clarify a point here. The 875 is my total staff at Kennedy and I do work for the DOD and I do other work for NASA on space stations and other things going on. Specifically, the 700 that I am working to are those that are for space lab contracts. Where the discrepancy comes from, I have no idea.

Mr. WALKER. We will have to ask NASA.

Thank you, Mr. Chairman.

Mr. ROE. I thank the gentleman.

Let me clarify for the record.

In your discussion and your response to Mr. Walker, do you oversee the installation of the payload into the orbiter or do you just bring it to the orbiter?

Mr. FAENZA. No. We work hand in hand with our SPC counterparts. They oversee it, but our requirements are in their procedures, and our people are there to assist them if there are questions.

Mr. ROE. Where does the jurisdiction end and start?

Mr. FAENZA. The jurisdiction is really a transfer, when we are on the hook.

Mr. ROE. Just one more point. How about the overtime situation? Have you been responsible for any of Lockheed's overtime problems that you are aware of?

Mr. FAENZA. Not directly. It is not a payload processing contractor problem. We have had payloads that have caused some question and concern, but nothing that drove any Lockheed concerns or overtime.

Mr. ROE. The gentleman from Florida.

Mr. LEWIS. Thank you, Mr. Chairman.

Just to follow upon the chairman's question, there have been no late manifest changes that would require you to work overtime?

Mr. FAENZA. For us to work overtime, oh, yes. We have had to support Rockwell just like—I mean Lockheed. When we get into one of these, it dominos through all of us. So if there is a late manifest or change out, we would support that and have to work overtime.

Mr. LEWIS. Have there been any what you could consider serious manifest changes to cause a change in the mission?

Mr. FAENZA. Several missions ago, and I don't recall the one where we actually changed the complement of the payload, but that was one where we all worked on it, changed out the payloads because one of the elements, a payload element malfunctioned and that was the only one.

Mr. LEWIS. Do you have a threshold where the SPC says that 12 hours is the maximum?

Mr. FAENZA. We have a standard practice that we work no employees over 12 hours.

Mr. LEWIS. I see.

Have you ever been to a point where your overtime where you had to say, "Stop, we are going to back off and let our workers rest?"

Mr. FAENZA. In our offline facilities—we have never been there on the online facilities, but in our offline facilities, for example, if we were running through an integrated test of the total complement, we would find a breakpoint and when we get into that point, we work with NASA and we decide to cut the testing down and reconvene in the morning.

Mr. LEWIS. Have you ever been a part of the manifest change because of a schedule slip?

Mr. FAENZA. No, sir.

Mr. LEWIS. Who is responsible for certifying that the payload has met all of the safety and quality assurance requirements?

Mr. FAENZA. That is a long question. It starts with the phased safety reviews that they run out of JSC. When a payload is manifested, it starts with a three-phase system that the payload owner has to satisfy the JSC folks that he is ready to fly and we in turn once we get the bird at our place, we have our safety considerations and requirements that we work to along with NASA safety.

As we come up on line and go through our reviews, we as an integrated team between myself and NASA and NASA safety and NASA qual. and my safety and NASA qual. handle all the qualifications for our piece of the work. So we are responsible for that piece as it relates to processing.

Mr. LEWIS. I see.

In your memo, memorandum, in your testimony, you are stating that you have a memorandum of understanding.

Mr. FAENZA. Yes, sir.

Mr. LEWIS. An agreement with the shuttle processing contractor. Do you have a similar one with the base operations contractor, EG&E?

Mr. FAENZA. No, sir, because we don't have a real direct requirement for a focused interface. When I work with EG&G, we essentially do it by the scheduling media. There is a support schedule that comes out where we attend it and then call up his support.

For example, if we need some air-conditioning or something, then we schedule up in that regime. It just doesn't have the same need for that kind of agreement.

Mr. LEWIS. When does your responsibility end when the payload is turned over to the SPC?

Mr. FAENZA. Well, we stay with the responsibility for the payload as a payload all the way through the launch. We support the SPC during the countdown. We do not have the responsibility of the integrated envelope, though, so if there is something happening with a payload, I am usually there during a launch as well as part of the management team, plus my launch team members are at their consoles supporting the NASA and the SPC test conductor and test director.

So we always keep a string on the responsibility of the payload along with our customer, because generally any of the customers that are flying are there with us so we have the commercial customer or the science customer and whoever else might be flying.

Mr. LEWIS. I thank the gentleman.

Thank you, Mr. Chairman.

Mr. ROE. I thank the gentleman from Florida.

We have no further questions. We thank you for your testimony.

The committee stands adjourned until next Wednesday at 2 o'clock.

[Whereupon, at 12:50 p.m., the committee adjourned, to reconvene at 2 p.m., Wednesday, July 23, 1986.]

INVESTIGATION OF THE CHALLENGER ACCIDENT

(Volume 2)

WEDNESDAY, JULY 23, 1986

House of Representatives,
Committee on Science and Technology,
Washington, DC.

The committee met, pursuant to call, at 2:30 p.m., in room 2318, Rayburn House Office Building, Hon. Robert Roe (acting chairman of the committee), presiding.

Mr. Roe. The committee will come to order.

We want to welcome our distinguished witnesses and apologize for the delay we have encountered. We just had a matter on the floor we had to deal with.

This afternoon we begin 2 additional days of inquiry from our former and current distinguished NASA officials who had policy or management responsibility for the Space Shuttle Program.

With these hearings, the Committee on Science and Technology commences its 5th week in the investigation of the space shuttle *Challenger* explosion and the evaluation of the Rogers' Commission findings on the accident.

As we hear from and question officials who have, or have had, responsibility for the Shuttle Program from its design and development stages to the present demonstration stage of shuttle operation, we will be particularly attentive to the evolution both of change in philosophy or function.

Change can occur even without a modification of policy, just through the varied interpretation and implementation of policy over time and under different leadership. This kind of change is often so gradual and incremental that it is undetected by the participants in the process, and unrecognized by the overseers of a program.

In NASA's almost three decades of operation, it has had many fine administrators and program managers, some of whom will be with us during these 2 days.

This afternoon, we will hear from Alan Lovelace, vice president and general manager of General Dynamics Space Systems Division. Dr. Lovelace held several positions at NASA including Associate Administrator, Deputy Administrator, and then Acting Administrator during his 9 years from 1972 to 1981.

Also with us is John Yardley, president of the McDonnell Douglas Astronautics Co. Mr. Yardley was NASA's Association Administrator for Space Transportation Systems from 1974-1981.

Does the gentleman from California have an opening statement?

Mr. PACKARD. I don't have an opening statement, Mr. Chairman. I simply want to say we are grinding down to a conclusion of these long and rather arduous and difficult hearings, very important, however, because of the significance of the future of the Space Program.

I am looking forward to the testimony and appreciate your coming here today.

Thank you, Mr. Chairman.

Mr. ROE. We have been through three phases. One is actually what happened from a technological point of view. The second point we want to explore with you further is the management issue and communications issue and then any thought processes you may have looking down the road from your vast experience, what do you see, directions and dimensions you see the Space Program should follow.

Having said that, I now would call on our distinguished first witness, Dr. Lovelace.

STATEMENT OF DR. ALAN M. LOVELACE, VICE PRESIDENT AND GENERAL MANAGER, SPACE SYSTEMS DIVISION, GENERAL DYNAMICS CORP.

Dr. LOVELACE. Thank you, Mr. Chairman.

I would, with your permission, like to cover a portion of my statement and submit the whole statement for the record.

Mr. ROE. No objection. So ordered.

Dr. LOVELACE. I appreciate the invitation extended to appear before the committee today and I know I share your deep sense of regret concerning the tragic loss of the *Challenger* which has led to these hearings. However, I firmly believe that the loss of these young people will have meaning only to the extent that those of us involved in the Space Program, Congressmen, Government officials, and businessmen alike, join together and make a real commitment to re-invigorate the U.S. space effort.

It is this renewed commitment that I wish to underscore today, Mr. Chairman. The loss of the *Challenger* has forced this Nation to totally reassess the direction of and commitment to its space effort.

Much of the reassessment has already been conducted by the Presidential Commission appointed to examine the *Challenger* accident. I would like to go on record here that I believe the Commission did a remarkable job under severe time constraints, both in getting to the root of the problems that led to the accident and making some very appropriate and important recommendations.

I have carefully reviewed these recommendations and they seem to fall into two major categories, technical and management. I certainly support the technical recommendations as prudent actions to be taken in the aftermath of this accident. Additionally, the management recommendations constitute a set of actions which should strengthen procedures and processes and remove undue pressures.

I would like now to address just a couple of individual recommendations. With respect to recommendation VIII on flight rate, I know this committee is well aware of the dangerous combination of an over-ambitious launch schedule and the lack of an adequate alternative launch capability.

The committee has already begun tackling this aspect of the overall problem by conducting a series of hearings on assured access to space. At these hearings Congressman Nelson challenged those of us in the aerospace business to get out our sharp pencils and thoroughly examine the potential of a viable, expendable launch vehicle industry.

In continued hearings, Congressman Nelson reiterated this challenge and stated that America needs a new, vigorous, expendable launch workhorse.

Congressman Walker emphatically stated the country needs to aggressively pursue a course of action that will permit the re-establishment of a robust ELV industry. I agree with both the Presidential Commission's recommendations and the sense of this committee that such an approach is absolutely necessary.

The Commission's recommendations relative to the shuttle safety panel reporting to the STS Program manager, as well as their recommendation concerning the Office of Safety, Reliability and Quality Assurance reporting directly to the NASA administrator seem to re-establish the importance and awareness of safety, both in the Shuttle Program as well as in all NASA undertakings.

I believe Dr. Fletcher has already moved to establish the latter office.

Finally, I would concur in the sense of the Commission's recommendations concerning the essentiality of the program manager's authority and the perennial need to improve communications.

With that, Mr. Chairman, I would conclude my remarks and be prepared to answer any questions that you might have.

[The prepared statement of Dr. Lovelace follows:]

STATEMENT OF

Dr. Alan M. Lovelace

Vice President and

General Manager

SPACE SYSTEMS DIVISION

GENERAL DYNAMICS CORPORATION

Before the

COMMITTEE ON SCIENCE AND TECHNOLOGY

UNITED STATES HOUSE OF REPRESENTATIVES

July 23, 1986

I appreciate the invitation extended to appear before the Committee today. I know I share your deep sense of regret concerning the tragic loss of the CHALLENGER which has led to these hearings. However, I firmly believe that the loss of those young people will have meaning only to the extent that those of us involved in the space program -- Congressmen, government officials, and businessmen alike -- join together and make a real commitment to reinvigorate the United States space effort.

It is this renewed commitment that I wish to underscore today. Mr. Chairman, the loss of the CHALLENGER has forced this nation to totally reassess the direction of, and commitment to, its space effort. Much of this reassessment has already been conducted by the Presidential Commission appointed to examine the CHALLENGER accident. I would like to go on record here that I believe the Commission did a remarkable job under severe time constraints, both in getting to the root of the problems that led to the accident, and in making some very appropriate and important recommendations.

I have carefully reviewed these recommendations. They seem to fall into two categories: technical/programmatic and management. I certainly support the technical recommendations as prudent actions to be taken in the aftermath of this accident. Additionally, the management recommendations constitute a set of actions which should strengthen procedures and processes and remove undue pressures.

I would now like to address some of the individual recommendations. With respect to Recommendation VIII on Flight Rate, I know that this Committee is well aware of the dangerous combination of an over-ambitious launch schedule and the lack of an adequate alternative launch capability. The Committee has already begun tackling this aspect of the overall problem by conducting a series of hearings on assured access to space. You may recall that I testified at those hearings on March 6 of this year. At those

hearings, Congressman Nelson challenged those of us in the aerospace business to get out our "sharp pencils" and thoroughly examine the potential of a viable expendable launch vehicle (ELV) industry. In continuing hearings, Congressman Nelson reiterated this challenge, and stated that America needs a new vigorous expendable launch "workhorse." Congressman Walker emphatically stated that the country needs to aggressively pursue a course of action that will permit the re-establishment of a robust ELV industry. Mr. Chairman, I fully agree with both the Presidential Commission's recommendation, and the sense of this Committee that such an approach is absolutely necessary.

By all accounts, an eminently sensible step would be to implement the Commission's recommendation, as well as the desires of this Committee, to establish an alternative launch vehicle capability to the shuttle. Not only do we need such a capability as a matter of national security and economic advantage, we also need it as an important element of safety in our future shuttle operations. It could provide a suitable transition to a reliable, robust, low cost, next-generation space transportation capability.

The Commission's recommendation relative to a shuttle safety panel reporting to the STS Program Manager, as well as the recommendation concerning an Office of Safety, Reliability and Quality Assurance reporting directly to the NASA Administrator seem to re-establish the importance and awareness of safety both in the Shuttle program as well as in all NASA undertakings. I believe Dr. Fletcher has already moved to establish the latter office. Finally, I would concur in the sense of the Commission's recommendations regarding the essentiality of the Program Manager's authority and the need to improve communications.

I would like to close by recalling the remarks of a youthful American President who chose to commit us to the challenge of space. In accepting this challenge, President Kennedy remarked "If

we are not determined to lead in space, then we cannot expect to lead on earth." That concise statement just as truly summarizes our situation today as it did twenty-five years ago. We did not shrink from the challenge then, and we must not shrink today. Rather, we -- Congressmen, government officials, and businessmen -- must overcome the nagging doubts and indecisiveness that currently plagues our space effort and recapture the spirit, invigoration, and vision that accompanied our original commitment to accept the challenge of space.

Mr. ROE. I thank the gentleman.
The Chair now recognizes Mr. John Yardley.

STATEMENT OF JOHN F. YARDLEY, PRESIDENT, McDONNELL DOUGLAS ASTRONAUTICS CO.

Mr. YARDLEY. Good afternoon, Mr. Chairman, members of the committee.

My name is John Yardley and I am president of the McDonnell Douglas Astronautics Co., which is one of the divisional companies of the McDonnell Douglas Corp.

We have been involved in the Manned Space Program beginning with the Mercury Program, the Gemini Program, Skylab Program, Saturn, Delta, and so on.

So my own personal involvement for the last 28 years has been mostly space. In 1974, I left McDonnell Douglas to come to NASA for 7 years as the Associate Administrator for Manned Space Flight. That title was changed to Space Flight and then changed to Space Transportation Systems.

Basically, the shuttle was paper when I got there and it flew before I left. Rather than try to get into detailed discussions on the Rogers' Commission Report, I think I will just wait for the questions.

In general, I would like to say that I think the Rogers' Commission did a good job. I agree with most of their recommendations, but not all. I think I would like to ask the chairman to put my written remarks in the record.

Mr. ROE. No objection. So ordered.

[The prepared statement of Mr. Yardley follows:]

STATEMENT OF

JOHN F. YARDLEY

PRESIDENT, MCDONNELL DOUGLAS ASTRONAUTICS COMPANY

BEFORE THE COMMITTEE ON SCIENCE & TECHNOLOGY

23 JULY 1986

GOOD AFTERNOON MR. CHAIRMAN AND MEMBERS OF THE COMMITTEE.

MY NAME IS JOHN YARDLEY AND I AM PRESIDENT OF THE MCDONNELL DOUGLAS ASTRONAUTICS COMPANY, A DIVISION OF THE MCDONNELL DOUGLAS CORPORATION.

AS YOU ARE AWARE, MR. CHAIRMAN, THE MCDONNELL DOUGLAS CORPORATION HAS A LONG HERITAGE IN SPACE ACTIVITIES. MCDONNELL AIRCRAFT COMPANY BUILT THE MERCURY AND GEMINI MANNED VEHICLES WHILE THE DOUGLAS COMPANY HAS A HISTORY THAT INCLUDES THE DELTA LAUNCH VEHICLE AND THE SATURN SIVB STAGE. IN 1967 THE TWO COMPANIES MERGED THEIR RESOURCES AND BUILT THE SKYLAB, THE FREE WORLD'S FIRST AND THUS FAR ONLY MANNED SPACE STATION. ADDITIONALLY, MCDONNELL DOUGLAS HAS DEVELOPED THE PAYLOAD ASSIST MODULE (PAM), THE ONLY COMMERCIALLY DEVELOPED LAUNCH ASSIST VEHICLE IN THE HISTORY OF THE U.S. SPACE PROGRAM. FURTHERMORE, WE HAVE CONTINUED IN TECHNICAL SUPPORT OF NASA WITH CONTRACTS AT HOUSTON, TX, HUNTSVILLE, AL, AND AT THE KENNEDY SPACE CENTER.

MR. CHAIRMAN, I RELATE THIS BRIEF HISTORY NOT AS A COMMERCIAL FOR OUR COMPANY, ALTHOUGH WE ARE PROUD OF OUR HERITAGE, BUT AS A WAY OF ESTABLISHING OUR CREDENTIALS AS A LONG-TERM SUPPORTER OF MANNED SPACE EFFORTS.

THROUGHOUT THIS HISTORY I HAD THE PRIVILEGE OF PARTICIPATING IN EACH OF THESE PROGRAMS. I WAS ACTIVELY INVOLVED ON BOTH THE MERCURY AND GEMINI PROGRAMS. IN THE LATE 1960'S I MANAGED THE MCDONNELL DOUGLAS PROPOSAL EFFORTS ON THE SHUTTLE AND WAS INVITED, IN 1974, TO JOIN NASA AS ASSOCIATE ADMINISTRATOR - MANNED SPACE FLIGHT.

IN THAT POSITION MY DUTIES INCLUDED ALL MANNED SPACE FLIGHT INVOLVING SHUTTLE, SKYLAB AND THE APOLLO-SOYUZ MISSION.

I RETURNED TO MCDONNELL DOUGLAS IN 1981, SHORTLY AFTER THE FIRST SHUTTLE FLIGHT.

MR. CHAIRMAN, IN YOUR LETTER OF INVITATION YOU REQUESTED MY COMMENTS ON THE FINDINGS AND RECOMMENDATIONS OF THE ROGERS' COMMISSION REPORT.

AFTER A REVIEW OF THE PUBLISHED REPORT OF THE PRESIDENTIAL COMMISSION ON THE SPACE SHUTTLE ACCIDENT, I FEEL THAT THE REPORT IS BALANCED AND FAIR. THE FACT THAT THE COMMISSION AND ITS SUPPORT TEAM WAS ABLE TO QUICKLY DETERMINE THE CAUSE OF THE ACCIDENT IS ENCOURAGING AND A CREDIT TO THE ABILITIES OF THE INVESTIGATION TEAM.

AS WAS NOTED IN THE REPORT, NASA HAS DELIVERED TO THE PEOPLE OF THE UNITED STATES AND THE WORLD OVER 25 YEARS OF TECHNOLOGICAL EXCELLENCE AND SPELLBINDING ACCOMPLISHMENTS. THE TRAGEDY OF JANUARY AND THE FINDINGS OF THE REPORT WILL NOW ALLOW FOR A PERIOD OF INTROSPECTION AND RENEWAL FOR NASA AND ITS CONTRACTOR TEAM. FROM THIS REVIEW, I BELIEVE, NASA WILL EMERGE AS A STRONGER AND EVEN MORE CAPABLE AGENCY.

IN THE NEAR FUTURE, AFTER INCORPORATING THE RECOMMENDATIONS OF THE COMMISSION, NASA WILL RETURN TO SPACE AND LEAD THE WORLD IN SPACE EXPLORATION AND RESEARCH. IN A SERIES OF LOGICAL STEPS, INCLUDING RETURNING THE SHUTTLE FLEET TO FLIGHT STATUS AND DEVELOPMENT OF A SPACE STATION, NASA WILL MAKE THE SOLAR SYSTEM ACCESSIBLE TO ALL.

MR. CHAIRMAN, IN PARTICULAR TODAY YOU ASKED FOR MY COMMENTS ON THE MANAGEMENT STRUCTURE DURING MY TENURE AT NASA. I WANT TO STATE FOR THE RECORD THAT THE NASA STRUCTURE UNDER WHICH I SERVED WORKED VERY WELL FOR ME. OBVIOUSLY, THERE WERE SOME "BUMPS IN THE ROAD" TO SMOOTH ORGANIZATIONAL COOPERATION. HOWEVER, THESE "BUMPS" WERE NOT INSURMOUNTABLE. I THINK WE HAD A DEDICATED AND MOTIVATED TEAM. PEOPLE MAKE STRUCTURES WORK -- STRUCTURES DO NOT MAKE PEOPLE WORK TOGETHER. IF A TEAM SPIRIT PREVAILS AND LEADERS ENCOURAGE PARTICIPATION, PLANNING AND PRODUCTIVITY THE BEST IDEAS WILL COME TO THE FOREFRONT AND AN ORGANIZATION CAN MAKE GREATER ACHIEVEMENTS. NASA HAS DONE THIS IN THE PAST AND WILL CONTINUE TO DO SO IN THE FUTURE.

MR. CHAIRMAN, I LOOK FORWARD TO ANSWERING ANY QUESTIONS WHICH YOU OR THE COMMITTEE MAY HAVE TODAY.

Mr. ROE. Are you finished?

Mr. YARDLEY. Yes, sir.

Mr. ROE. You mentioned that—I was interested in your first comment when you said you agreed with—as I understand you—most of the recommendations, but some you did not. Immediately, that raises my interest in which ones you did not agree.

Mr. YARDLEY. I thought that might.

Mr. ROE. Could you give us an observation?

Mr. YARDLEY. The one in particular, that I think I have some background in, that I think is not correct is they are trying to strengthen the authority and responsibility of the program manager at Johnson. Let me just relate what happened when I went to NASA.

I hadn't been there but a couple of weeks and one of the other centers called me and said, hey, the program manager wants to take $15 million of my money and put it on the *Orbiter.* It became immediately apparent to me that to have one of the center people handle the funding decisions was not going to be in the best interests of cooperative technical activity.

So I pulled the final decisions on the money to Washington, where I think they still are—I am not sure if they have changed it since—but I had the program manager responsible for collecting the budgetary material, assessing it and making recommendations.

That put him in a position that he was able to work across the technical level quite well and, in fact, I would say I have never seen anybody from another center get along as well as Bob Thompson did.

He will be testifying tomorrow. So my recommendation would be not to put total program management control at one of the centers.

Mr. ROE. At any one of the centers?

Mr. YARDLEY. At any of the centers.

Mr. ROE. The Chair recognizes the gentleman from California.

Mr. PACKARD. Thank you, Mr. Chairman.

Mr. Lovelace, you certainly gave credence to the idea of balancing out our shuttle program, our manned space program with that of the unmanned.

What do you think would be an adequate balance, if you had to choose between a fourth orbiter, for example, and beefing up our unmanned program, what would be your recommendation?

Mr. LOVELACE. Well, Mr. Packard, it is a difficult question to answer and yet I know it is a question that the Congress must answer in terms of the budget constraints. I have testified before the Space Subcommittee of this full committee that I thought that a fourth orbiter was in the best interest of the country's space program and I still believe that.

I think, however, we have the necessity, at least for an interim period, of providing for some expendable launch vehicle capability, both to take care of some of the payloads that will be impacted during the time that the shuttle fleet is grounded, and to transition us into the future, which, I think will be a future that will contain both manned and unmanned launch capabilities.

The studies that are underway today regarding the architecture of the future space systems, seem to indicate that is the direction in which we are headed.

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Our difficulty is, how do we get from where we are today into that future as the unfortunate circumstances of the *Challenger* accident have put a real pressure on the budget.

Mr. PACKARD. The story in the Los Angeles Times quotes an unnamed Rogers' Commissioner as follows, "There was no management of the shuttle program. Even without the accident, the program would have ground to a halt by this point." The report itself tends to confirm this analysis, that there was inadequate management.

How did the major U.S. civilian space program reach such a position in terms of its management policies and was the problems due to management failures tied to our own policy or was it simply a failure to provide funding for adequate management decisions and what lesson should we learn from the first 5 years of the Shuttle Program in terms of management?

Mr. ROE. If you will answer that, we will all retire.

Mr. LOVELACE. If I could answer that very crisply, we could conclude these hearings, I suspect. I have not read the Los Angeles Times article, Mr. Packard, that you refer to. Also, I do not know who the author is, but I don't agree with the author that there was no management. I think that can hardly be the case. Surely the events that have transpired cause you to want to question whether we have the best management approach to the Shuttle Program.

I think that we certainly—those of us who were involved in the early development phase of the Shuttle Program—felt that we had a contractual commitment with the Congress to bring the shuttle on line, to bring the development to a satisfactory conclusion. The technical complexity and difficulty of that task certainly caused the great demands on the resources that were available. I think that most of us who were involved in that process attempted to manage the technical program and stay as best we knew how within the budget constraints.

Surely that put some pressure on us, but I think that, in fact, that is what you expect from management. That is why you put management in place, to try and deal with that balancing of risk and resources. I don't know that that process—I have not been familiar with it in detail since I left the agency—I don't know that that process has deteriorated at all.

Mr. PACKARD. Thank you. I don't have any further questions.

Mr. ROE. The gentleman from Florida.

Mr. NELSON. I thank the chairman.

Let me just underscore a point that one of the two of you made earlier. It says in the printed Rogers Commission report that there should be a consolidation in the program management at JSC, but, in fact, we understood it to mean that there was to be the control consolidated here at NASA Headquarters.

Is that what everybody's understanding is of the space transsystem?

Mr. YARDLEY. I don't have any information other than what is in the report. I just read the report, and I don't agree with what the report says.

Mr. NELSON. I see. You are saying that what you do agree with is that the control ought to be here at Headquarters.

Mr. YARDLEY. Yes. I think though, that the system we had with the overall fiscal control, at Headquarters, but the technical control at Johnson worked well. You know, you could put the technical systems people in Washington and still get the job done, because it really depends on the people you have got to do the job, and if they work together.

I would just like to add one other thing to Al's comment there. The fact that we did have a very challenging task in development, with a lot of technical problems, meant we had to get together quite often, and we had communication channels formed in that process, just naturally, that I think probably deteriorated. These are not policy, they are not organizational, they are not line diagrams. Once those problems went away and it got into an operational status, I just think people started not seeing each other very often, and the people who had gotten to know each other very well left. I think that is a lot of the problem.

Mr. LOVELACE. I think, Mr. Nelson, if I might go back to the Commission's recommendation, which I said I concurred with, my interpretation is they want to, in fact, strengthen that whole process. I can hardly argue with that.

The problem is the definition of what strengthens that process and what doesn't. I think John has very clearly pointed out how it was functioning at the time that he operated at level 1. In the summer of, I think it was 1979, we were, as a management team at NASA, struggling very much to contain the technical tasks to be done and the budgets that were available to do those tasks. I convened a group of consultants who came back with some recommendations, after talking with virtually all levels of management within the agency. One of the recommendations clearly was supportive of what Mr. Yardley has pointed out, and that is that it is very difficult, if not impossible, to have the financial and fiscal management done at a center in a level 2 management operation.

There is no doubt that Bob Thompson, during my tenure, did a superlative job in terms of being the systems manager and systems engineer for the space transportation system. But it became clear in that study that John needed to strengthen his staff, which he did, in terms of financial analysts to analyze the inputs that came to him through Mr. Thompson and from the centers and to arrive at the equitable distribution of resources to be applied to the remaining technical tasks to be done.

That worked, I believe, very well for us, at least up through the spring of 1981, which is really the horizon of my and John's personal involvement.

Mr. NELSON. Thank you, Mr. Chairman.

Mr. ROE. I thank the gentleman. You made one comment, Mr. Lovelace. You pointed out on the fourth orbiter—give us your thoughts on that. What we are hearing in different circles goes as follows, part of the scenario. Why don't we work with three orbiters? What do you need four for? That is what they are coming back to us and saying. Can't we do it with three? Should we hold up that whole program, go to a new generation, more sophisticated design? What is your observation?

You mentioned from your personal point of view, you felt we did need the fourth orbiter.

Mr. LOVELACE. I think the answer, Mr. Roe, hinges on what your expectation is for what you want the system to do; OK? If you don't want to field a space station in a reasonable forecast of time, then maybe we really don't need a larger space transportation system. I certainly am not one to deny that it might be useful to think eventually about a new space transportation system, new technology, and I think that that really will come to pass, but what I am concerned about is limiting our options for the U.S. Space Program by making some optimized decision surrounding whether we need a fourth orbiter, with everybody having different sets of expectations about what they would like the U.S. Space Program to be.

Mr. ROE. What you are basically saying is the next area we are getting into is the goals. What are the national goals? That seems to be very spunky at this point. When President Kennedy made his observations to go to the moon was the distinct direction the country was going to go in to achieve a specific goal, I think that was the motor that drove the program to begin with. Sometimes a lot of the witnesses we have been listening to and hearing people talk about goals they are talking about orient towards hardware rather than the point of view of what is it, what are we trying to achieve? Would you agree with that?

Mr. LOVELACE. I would agree with that. I am concerned, Mr. Chairman.

Let me make a very unrealistic statement. Setting budgets aside, which I understand, having spent a few years in this environment, is totally unrealistic, but setting that aside for the moment, I think that we have become very introspective and introverted in our thinking and analysis right now. That is important to do. We have done it. We understand what needs to be done.

Now, we ought to get on with fixing our space program. We ought to set ourselves some goal. That goal ought to be beyond next week.

Mr. ROE. Let me ask you another question to build on this, because we are going to be getting into this further on. Interesting, when I think it was two firms that were handling communication satellites down in Texas, from what I understand, had decided now they will go to China and have China do some launching for them, the Japanese are coming back and saying, well, we want to get more involved now in high technology. The Soviets, of course, we are well aware what they are doing.

There was an interesting article in the New York Times yesterday, Tuesday, whatever it was. Should we, in your judgment, be doing more cooperative work with other countries? In other words, if we are talking about multibillions of dollars to build our fleet and so forth, budget problems and so forth, should we be getting into more direct work as we did with the Soviets going back a few years ago?

Mr. LOVELACE. Well, I think that I am basically in favor, Mr. Chairman, of international cooperation. I think that the efforts underway relative to the international cooperation on space stations are the right things to do. I am also sensitive, however, to the point that many times that cooperation—and I hark back to the *Apollo-Soyuz* mission—was not always interpreted as being in this coun-

try's best interest. There was also much concern about technology transfer between our two countries as a result of close cooperation.

I tend, however, to believe that in terms of the Free world, we really must not become very insular in our technology cooperation, because that probably will lead to greater difficulties for us than to have a very healthy interchange within the Free world countries.

Mr. ROE. Mr. Yardley.

Mr. YARDLEY. I think I agree with Al, that considering all things, we ought to go ahead with the international cooperation. I think you can do that without real gut technology transfer. I went through the *Apollo-Soyuz* Program. It was one of my programs. The main thing the Russians got from us was how we managed our manned space program, which apparently nobody thinks is any good now anyway.

Mr. ROE. Are there any other questions?

The gentleman from Florida.

Mr. NELSON. I just want to make sure—four answers ago I didn't understand your answer. Do you agree—what is your opinion about a replacement orbiter?

Mr. LOVELACE. I believe we should have a replacement orbiter.

Mr. NELSON. Thank you.

Mr. YARDLEY. I agree with Al, too, by the way. He and I, our companies, are two of the three companies that are possibly the beneficiary of the expendables, too. I think we both take the position there ought to be a fourth orbiter.

Mr. ROE. Would you give me—I am trying desperately to get the reason why. People are coming back—let me set the stage for you.

The White House has been putsing around with this thing for the last 5 months, in fair play, and nothing has been decided at that level. There has been legislation introduced, but really nothing is moving on it. So we are at a point when people are coming back and saying why should we be doing—why can't we go with three? What do we have—other than fixing the seal, why do we have to have four? That is the question before us.

Then we come back, and Mr. Lovelace's testimony in earlier discussion, you came back and said one of the concerns was maybe we were pressing the system too hard by trying to get too many launches going, and we are taking things for granted. I think that is a fair comment.

Now, the question really is, why four? What is the magic of four? Why not three? Why not ten? I am not being facetious.

Mr. YARDLEY. My answer to that is that you have got to consider three orbiters as though it were two, because it is always going to be an orbiter getting fixed, upgraded, something else. Two is just too small a fleet to be a viable national program. The United States can't do the space station with two orbiters.

Mr. ROE. That is good.

Mr. LOVELACE. I think John is absolutely right, in my judgment. I think you have to think about our current fleet as two, at any given instant, two operational, functional orbiters. I don't think you can have a space station with that, and I think we should have a space station.

Mr. PACKARD. Would the chairman yield on that?

Mr. ROE. Yes.

Mr. PACKARD. The Administrator has now announced a schedule of 12 per year, 12 flights per year once we resume flights. Even with two functional, noncannibalized orbiters, that could be accommodated, 12 per year. By increasing it to three, actually four, but three for all intents and purposes, is it your judgment then that there will be a strong move and a desire to move above the 12 per year, or do you sense that that is a figure that we will probably try to retain, or will we try to move to 18 and then to 24 a year?

Mr. YARDLEY. I think the Administrator didn't put a ceiling of 12 on it. He said I think 12 in the first two years, didn't he?

Mr. LOVELACE. I think he talked about nine the first year and then building to 12.

Mr. YARDLEY. If you put the space station up with three orbiters, let's say, have a fourth for your margin, it is going to take a long time even at that. We are probably going to have to get expendable launch vehicles—I forget whether it is 14 or 16 launches it takes.

Mr. LOVELACE. I think it is 16.

Mr. YARDLEY. Something like that. So, you know, just to do it with less than four in your fleet, three operational, seems to me is just not feasible.

Mr. PACKARD. Thank you.

Mr. ROE. OK. I guess since there are no other questions, we want to thank you very much for being with us. I know it took a lot of time for you to get here, but you have been very helpful in your testimony, and we appreciate you being with us today.

The committee will stand adjourned until tomorrow at 9:30.

[Whereupon, at 3:20 p.m., the committee was adjourned until 9:30 a.m., Thursday, July 24, 1986.]

INVESTIGATION OF THE CHALLENGER ACCIDENT

(Volume 2)

THURSDAY, JULY 24, 1986

House of Representatives,
Committee on Science and Technology,
Washington, DC.

The committee met, pursuant to call, at 9:30 a.m., in room 2318, Rayburn House Office Building, Hon. Robert A. Roe (acting chairman of the committee), presiding.

Mr. Roe. The committee will convene.

Again, today's hearing, in both the morning and afternoon sessions, will continue the inquiry that we began yesterday to hear from former and current NASA officials involved with the Space Shuttle Program.

These sessions comprise another portion of the comprehensive series of hearings that the Committee on Science and Technology has been holding to investigate the space shuttle *Challenger* accident, and to review the Rogers Commission findings of the accident.

The committee's goal in this extensive process is to track the evolution of change in the routine function and operation of NASA activities. From these specifics, we hope to understand and help correct that pattern of change that may subtly have weakened the precision accountability of one of the world's most respected R&D organizations.

Today, we have a full roster of witnesses, all of whom held, and in some cases still hold, positions of policy or management of the Space Shuttle Program. In this morning's session, we will hear from Gen. James Abrahamson, Director of the Strategic Defense Initiative; and Mr. Jesse Moore, Director of the Lyndon Johnson Space Center.

We want to welcome our witnesses this morning.

The gentleman from New Mexico.

Mr. Lujan. I have no opening statement. I want to welcome General Abrahamson and Jesse Moore. It has been a pleasure being associated with both of you gentlemen all these years. I am sure we can learn a lot from you.

Mr. Roe. I thank the gentleman from New Mexico.

General, would you stand and be sworn in, please?

[General Abrahamson sworn.]

Mr. Roe. Without objection, television broadcast and still photographs will be permitted this week on the Rogers report. If no objection, so ordered.

We want to welcome you to our committee, General Abrahamson. I think it would be profitable to review that full statement for us, if you would. So, if the general will proceed.

STATEMENT OF LT. GEN. J.A. ABRAHAMSON, DIRECTOR, STRATEGIC DEFENSE INITIATIVE, THE PENTAGON

General ABRAHAMSON. I want to thank you for inviting me to testify before the Committee on Science and Technology today. I have appeared before this committee on numerous occasions, but none as tinged with nostalgia or the sadness as today.

I have been asked to comment on the Report of the Presidential Commission on the Space Shuttle Accident. As I was formulating my thoughts to do so, I reflected back upon the history of manned space flight, including the precursor, the ascent of the dog, Laika, and the monkeys, Able and Baker. I remember how our imagination was fired up when Soviet Cosmonaut Yuri Gagarin orbited the Earth and the triumph that we all felt as the United States succeeded in Project Mercury.

I remembered how, in the early 1960's, when we were all much younger, the names of Shirra, Shepherd, Carpenter, Cooper, Slayton, Grissom, and Glenn captivated our attention. We marveled at what was going on and at the new thresholds that we were crossing. We marveled that men and women could fly in space and return safely to Earth.

Although there were other tragedies and setbacks, such as the *Apollo* fire, manned space flight succeeded and we watched with vicarious pleasure as the United States built a space program that was the pride of America and the envy of the world. Yet, just 6 months ago, on January 28, the space shuttle *Challenger* blew up in front of the whole world, and we were confronted with a stark reality and a strong impression that things were now different.

For all of us, for all mankind, it was a tragedy. It was a tragedy for all because it represented a loss of life; and, for some, it represented a loss of hope. A loss of hope perhaps, because no matter where in the world one went—be it Senegal, Chile, or even Easter Island, the most remote inhabited spot in the world—one could see the evidence of the pride that people had in the Space Shuttle Program.

The space shuttle gave rise to expectations that whatever the United States set out to do, it could do it. What happened on January 28, 1986 did not change that fact. It should not and must not change those hopes and expectations.

I worked in the Space Shuttle Program for over 2½ years. I had friends who lost their lives that day. I didn't have the pleasure of knowing Greg Jarvis or Christa McAuliffe, but I did know Dick Scobee, Ron McNair, Mike Smith, Ellison Onezuka, and Judy Resnick. I did have the pleasure of working with them and some of their fellow crews. They didn't die a meaningless death.

They were pioneers in every sense of the word, but they weren't martyrs. They were pioneers who lost their lives in advancing the frontier of mankind's knowledge. I know that they would say boldly that our capability to create and to overcome obstacles

didn't change on January 28. They would affirm that our capability will always be there.

It will always be there because we have a free and wonderful system in this country that still permits us to do whatever we set our mind upon. If our objective is to implement the strategic defense initiative or to create a new Space Shuttle Program, we can and we will do it.

Nothing in the Presidential Commission report contradicts this. The report is a good and a fair document. Its recommendations are sound and significant actions to implement the recommendations have already been taken by NASA.

The report contains an eloquent covering letter by Commission Chairman William P. Rogers to President Reagan. Mr. Rogers wrote that, "The nation's task now is to move ahead to return to safe space flight and to its recognized position of leadership in space. There could be no more fitting tribute to the *Challenger* crew than to do so." I agree completely with Mr. Rogers, and it is in that vein that I offer the following comments.

The report stated that, "NASA has always taken a positive approach to problem solving"—which is very true. But it also stated that NASA had "* * * not evolved to the point where its officials are willing to say they no longer have the resources to respond to proposed changes."

That was not my experience at NASA. At no time during my tenure as the NASA Associate Administrator for Space Flight did the organization, the NASA System, fail to argue for the rational, instead of the impractical or the impossible. A number of scheduled missions were routinely slipped, not for crew or payload manifest changes, but to ensure optimal availability of resources, and above all, flight safety.

The report also stressed that an operational program, "* * * should not imply any less commitment to quality or safety, nor a dilution of resources." The attitude, the report adds, should be, "We are going to fly high risk flights this year; every one is going to involve some risk. So we had better be careful in our approach to each." This, from my experience, has been precisely the NASA attitude.

From 1981 to 1984, we continuously acquired new information on the space shuttle. We had to strike a delicate balance between the need for continued flight testing and the need for an operational National Space Transportation System. We also had to strike the fundamental balance that any flight test program must achieve: specifically, flights must go on to gain knowledge of performance and strengths and weaknesses in the System. But each flight must be safe. Consequently, every flight was regarded as a learning experience and a challenge, a challenge which required decisions at each step along the way.

Manned space flight has never been nor will it likely ever be a matter of deciding at the beginning of a mission what has to be done, and then rigidly sticking to a prescribed plan, irrespective of conditions and circumstances. Rather, it was, and is, a process of continuing to build upon lessons learned and of continuing to make necessary tradeoffs. Operating the shuttle, or any manned system, will never be simple, nor will it be one in which absolute reliance

can be placed solely on analytical techniques, as opposed to intuition, good seasoned judgment, and experience.

In this respect, the report has criticized the NASA decision process and characterized it as flawed. Relative to the Solid Rocket Booster, SRB, O-ring problem, the criticism is warranted: the seriousness of the problem was largely overlooked; failure to correct it was inexcusable. On this occasion, the system broke down with disastrous consequences.

It should not have broken down. There were ample warning signs. By January 1986, a December 1982 NASA document, which recognized the problem, but also cited that a total of 1,256 SRB joints incorporating O-ring seals, that document was largely no longer relevant. Worse, it gave a false sense of security.

The report properly focuses on the breakdown in the decision process on this incident, and this focus has been amplified in the media. Unfortunately, the negative media reporting has not been accompanied with an examination of how the NASA System also worked right. This perspective should not be lost.

I would like to provide instances from my experience in which I thought both the people and the System worked correctly. On STS-5, we had scheduled the first space shuttle extra vehicular activity, EVA. In the prespacewalk checkout, we had spacesuit problems and we canceled the EVA. After that flight and prior to the time we tried again, the entire NASA System bore down on the quality assurance problem we unearthed, and it implemented long-term corrections.

One of our most subtle and difficult problems happened to develop just prior to the first flight of the *Challenger.* In a readiness firing, we noted a trace of hydrogen in the *Challenger*'s engine compartment. There were many conflicting opinions and some very even rational explanations as to why it was safe to fly. However, NASA's people, with their contractor teammates, doggedly pursued the potential problem.

I know, because I saw it work at every level, including the technicians who took exceptional risks on the pad to search for and finally locate a real hydrogen leak. This enabled us to pinpoint a host of quality assurance, acceptance testing, and manufacturing problems; and, concurrently, to solve them through extraordinary efforts, including major new investments in engine spares, automated welding equipment, revised plant layouts, and new standards of personnel training and quality assurance.

There are many other examples I could cite of the System working properly. However, I merely ask this committee and the American people to remember the positive as well as the failures that led to the tragedy of January 28. During my tenure, I felt the NASA team—government and contractors—always did more than asked. At no time did I ever encounter anyone who did not put flight safety first and foremost in their considerations.

As I stated earlier, the Commission's recommendations are valid and sound, and I believe they are being effectively implemented by NASA. However, I would also like to point out that many of these recommendations have long been incorporated in NASA management procedures. The program manager, by definition, has the necessary authority to get the job done.

What the program manager must ensure is that program objectives do not get blurred in transmitting them through necessary channels, including the Office of Management and Budget and the Congress. The program manager must further recognize that there will be a constant need to check that directives are adequately carried out and he must also recognize that he is an important cog—but, nonetheless, only one cog in a vital, dynamic System.

Throughout my tenure, astronauts were in key program office positions and one served as an Assistant Associate Administrator in the Office of Space Flight; that is, to me. In addition, no one could have been more visible or more involved in the NASA decisionmaking process than were Deke Slayton and, later, John Young. Both made important management contributions and both were important team members.

I am pleased that the Commission recommended greater visibility of the NASA safety and quality assurance organizations. These are people whose important contributions are often not very visible in any technical effort; yet, they must be key ingredients within the decisionmaking process.

I recall that when we established the important Dakar Contingency Landing Site, Mr. Beggs and I insisted that the Kennedy Space Center Deputy Director for Safety, Security, and Quality, serve as one of that site's initial team chiefs. He served, did a tremendous job, and we all breathed easier for his insight and his leadership.

I agree completely with the commission that there must be an effective communication access. To avoid a fatal communications breakdown, managers at all levels must have access to key NASA officials. This access can be accomplished within the current chain of command. However, it must be facilitated through communication devices and encouraged by an atmosphere that motivates the managers to come forward with problems.

The final result of a beneficial communications atmosphere must be a complementary relationship between the program managers, functional staffs, and using and support organizations. Nonetheless, this process can be successful only if the managers are willing to accept responsibility for their decisions, whether they are reached individually or by consensus.

I don't believe that the *Challenger* accident or the media reporting has significantly eroded the American people's fundamental confidence and support of the Space Shuttle Program. However, this confidence and support will endure only as long as we demonstrate a willingness to respond positively to our new challenge.

For example, the Presidential Commission and NASA have identified several problems and they have identified several corrective actions. Success in resolving those problems must extend across the board. The solutions must involve the Space Transportation System as a whole, including payload and facilities in space. The proposed solutions must examine every aspect of shuttle operations, including turnaround times, productivity enhancements, and the need for a new orbiter.

If we don't succeed, then our Nation—and the free world—will be driven back to an overwhelming reliance on expendable launch vehicles. In my opinion, we will then have taken a major step back-

ward. Without the shuttle, we will revisit the sixties and the seventies, and we will have failed to capitalize on the tremendous opportunity that the Shuttle Program presents in improving the quality of life for all mankind.

The *Challenger* tragedy has not been our only recent launch vehicle system failure. As we all know, our space program has been further crippled by two Titan accidents and the failure of an "old-reliable" Delta; the European space effort has suffered the loss of an Ariane rocket. Although some of these were recently manufactured vehicles, there is at least one common link in these failures. The problems, that we are aware of, have all occurred in subsystems that represent older technology. The solid rockets, the electronic components, the mechanical designs, are all representative of 1970 technologies and not of what we can do today.

There is a lesson that can be drawn from the commission report. That lesson is that we must continue to invest people and resources into research and the creative process of implementing research results into new and safer designs, improved methods of testing and quality assurance, and, most of all, allowing our talents to be used to their utmost.

It is not enough to assume that because a machine worked properly before, it will work properly again. If the machine fails, it is not enough to assert that a management fix is all that is required to correct the problem. Ladies and gentlemen of this important committee, every one of you, every one of us, has the challenge and the responsibility to not merely fix blame, but to provide every possible measure of support to NASA and the vital Space Program.

First, it means a fundamental appreciation of the cadre of pioneers who have built a part of our national space program that has been the pride of America and the world. Second, it means that we must provide the resources to restore the Space Shuttle Program as well as to broaden our expendable launch vehicle fleet—and this means investment in modernization as well as buying more of the same.

Third, it means that we must provide a declaration of support for our space program, one that acknowledges that all of these programs contribute to a better quality of life on earth. This would be in the spirit of our *Challenger* pioneers, and it would be the bond of faith with future generations.

[The prepared statement of General Abramson follows:]

TESTIMONY: LIEUTENANT GENERAL J. A. ABRAHAMSON

US HOUSE OF REPRESENTATIVES
COMMITTEE ON SCIENCE AND TECHNOLOGY

24 July 1986

Mr. Chairman, thank you for inviting me to testify before the Committee on Science and Technology today. I have appeared before the Committee on numerous occasions, but none as tinged with nostalgia and sadness as today.

I have been asked to comment on the Report of the Presidential Commission on the Space Shuttle Accident. As I was formulating my thoughts to do so, I relfected back upon the history of manned space flight, including the ascent of the dog, Laika and the monkeys, Able and Baker. I remember how our imagination was fired-up when Soviet Cosmonaut Yuri Gagarin orbited the earth and the triumph that we all felt as the United States succeeded in Project Mercury. I remembered how, in the early 1960s (when we were much younger), the names of Shirra, Shepherd, Carpenter, Cooper, Slayton, Grissom, and Glenn captivated our attention. We marveled at what was going on and at the new thresholds that we were crossing. We marveled that men and women could fly in space and return safely to earth. Although there were early tragedies and setbacks, such as the Apollo fire, manned space flight succeeded and we watched with vicarious pleasure as the United States built a space program that was the pride of America and the envy

of the world. Yet, just six months ago on the 28th of January, the Space Shuttle Challenger blew up in front of the whole world and we were confronted with a stark reality and a strong impression that things were now different.

For all of us, for all mankind, it was a tragedy. It was a tragedy for all because it represented a loss of life and for some, it represented a loss of hope. A loss of hope perhaps, because no matter where in the world one went, be it Senegal, Chile, or even Easter Island, the most remote inhabited spot in the world, one could see the evidence of the pride that people had in the Space Shuttle program. The Space Shuttle gave rise to expectations that whatever the United States set out to do, it could do it. What happened on the 28th day of January 1986 did not change that fact. It should not and must not change those hopes and expectations.

I worked in the Space Shuttle program for over two and one-half years. I had friends who lost their lives that day. I didn't have the pleasure of knowing Greg Jarvis or Christa McAuliffe, but I did know Dick Scobee, Ron McNair, Mike Smith, Ellison Onezuka and Judy Resnick. I did have the pleasure of working with them and some of their fellow crews. They didn't die a meaningless death.

They were pioneers in every sense of the word, but they weren't martyrs. They were pioneers who lost their lives in advancing the frontier of mankind's knowledge. I know that they would say boldly that

our capability to create and to overcome obstacles didn't change on the 28th of January. They would affirm that our capability will always be there. It will always be there because we have a free and wonderful system in this country that still permits us to do whatever we set our mind upon. If our objective is to implement the Strategic Defense Initiative or to create a new Space Shuttle program, we can and we will do it.

Nothing in the Presidential Commision report contradicts this. The report is a good and a fair document. Its recommendations are sound and significant actions to implement the recommendations have already been taken by NASA.

The report contains an eloquent covering letter by Commission Chairman William P. Rogers to President Reagan. Mr. Rogers wrote that "The nation's task now is to move ahead to return to safe space flight and to its recognized position of leadership in space. There could be no more fitting tribute to the Challenger crew than to do so." I agree completely with Mr. Rogers and it is in that vein that I offer the following comments.

The report stated that "NASA has always taken a positive approach to problem solving" -- which is very true -- but it also stated that NASA had ". . . not evolved to the point where its officials are willing to say they no longer have the resources to respond to proposed changes." That was not my experience at NASA. At no time during my tenure as the

NASA Associate Administrator for Space Flight did the organization, the NASA system, fail to argue for the rational, instead of the impractical or the impossible. A number of scheduled missions were routinely slipped, not for crew or payload manifest changes, but to insure optimal availability of resources and above all, flight safety.

The report also stressed that an operational program "should not imply any less commitment to quality or safety, nor a dilution of resources." The attitude, the report adds should be, "We are going to fly high risk flights this year; every one is going to involve some risk, so we had better be careful in our approach to each." This, from my experience, has been precisely the NASA attitude.

From 1981 to 1984, we continuously acquired new information on the Space Shuttle. We had to strike a delicate balance between the need for continued flight testing and the need for an operational National Space Transportation System. We also had to strike the fundamental balance that any flight-test program must achieve: specifically, flights must go on to gain knowledge of performance and strengths and weaknesses in the system - but each flight must be safe. Consequently, every flight was regarded as a learning experience and a challenge - a challenge which required decisions at each step along the way.

Manned space flight has never been nor will it likely ever be a matter of deciding at the beginning of a mission what has to be done - and then rigidly sticking to a prescribed plan, irrespective of

conditions and circumstances. Rather, it was - and is - a process of continuing to build upon lessons learned and of continuing to make necessary tradeoffs. Operating the shuttle, or any manned system, will never be simple, nor will it be one in which absolute reliance can be placed solely on analytical techniques, as opposed to intuition, good seasoned judgment, and experience.

In this respect, the report has criticized the NASA decision process and characterized it as "flawed". Relative to the Solid Rocket Booster (SRB) "O" Ring problem, the criticism is warranted: the seriousness of the problem was largely overlooked; failure to correct it was inexcusable. On this occasion, the system broke down with disasterous consequences. It should not have broken down: there were ample warning signs. By January 1986, a December 1982 NASA document, which recognized the problem, but also cited that a total of 1,256 SRB joints incorporating "O" Ring seals had been successfully tested with no evidence of leakage was clearly no longer relevant. Worse, it gave a false sense of security.

The report properly focuses on the breakdown in the decision process on this incident, and this focus has been amplified in the media. Unfortunately, the negative media reporting has not been accompanied with an examination of how the NASA system also worked right! This perspective should not be lost. I would like to provide instances from my experience in which I thought both the people and the system worked

correctly. On STS-5, we had scheduled the first Space Shuttle extra vehicular activity(EVA). In the pre "space-walk" checkout, we had spacesuit problems and cancelled the EVA. After that flight and prior to the time we tried again, the entire NASA system bore down on the quality assurance problem we unearthed and it implemented long term corrections.

One of our most subtle and difficult problems happened to develop just prior to the first flight of the Challenger. In a readiness firing, we noted a trace of hydrogen in the Challenger's engine compartment. There were many conflicting opinions and some very even rational explanations as to why it was safe to fly. However, NASA's people with their contractor teammates doggedly pursued the potential problem. I know because I saw it work at all levels, including the technicians who took exceptional risks on the pad to search for and finally locate a real hydrogen leak. This enabled us to pinpoint a host of quality assurance, acceptance testing and manufacturing problems - and, concurrently, to solve them through extraordinary efforts including major new investments in engine spares, automated welding equipment, revised plant layouts and new standards of personnel training and quality assurance.

There are many other examples I could cite of the system working properly. However, I merely ask this committee and the American people to remember the positive as well as the failures that led to the tragedy

of the 28th of January. During my tenure, I felt the NASA team -- government and contractors -- always did more than asked. At no time did I ever encounter anyone who did not put flight safety first and foremost in their considerations.

As I stated earlier, the commission's recommendations are valid and sound and I believe they are being effectively implemented by NASA. However, I would also like to point out that many aspects of these recommendations have long been incorporated in NASA management procedures. The program manager, by definition, has the necessary authority to get the job done. What the program manager must ensure is that program objectives do not get blurred in transmitting them through necessary channels, including the Office of Management and Budget and the Congress. The program manager must further recognize that there will be a constant need to check that directives are adequately carried out and he must also recognize that he is an important cog, but, nonetheless, only one cog in a vital, dynamic system.

Throughout my tenure, astronauts were in key program office positions and one served as an Assistant Associate Administrator in the Office of Space Flight. In addition, no one could have been more visible or more involved in the NASA decision making process than were Deke Slayton and later, John Young. Both made important management contributions and both were important team members.

I am pleased that the commission recommended greater visibility of the NASA safety and quality assurance organizations. These are people

whose important contributions are often not very visible in any technical effort and they must be key ingredients within the decision making process. I recall that when we established the important Dakar Contingency Landing Site, Mr. Beggs and I insisted that the Kennedy Space Center Deputy Director for Safety, Security, and Quality serve as one of the site's initial team chiefs. He served, did a tremendous job and we all breathed easier for his insight and his leadership.

I agree completely with the commission that there must be effective communications access. To avoid a fatal communications breakdown, managers at all levels must have access to key NASA officials. This access can be accomplished within the current chain of command. However, it must be facilitated through communication devices and encouraged by an atmosphere that motivates the managers to come forward with problems. The final result of a beneficial communciations atmosphere must be a complementary relationship between the program managers, functional staffs, and using and support organizations. Nonetheless, this process can be successful only if the managers are willing to accept responsibility for their decisions, whether they are reached individually or by concensus.

I don't believe that the Challenger accident or the media reporting has significantly eroded the American people's fundamental confidence and support of the Space Shuttle program. However, this confidence and support will endure only as long as we demonstrate a willingness to respond positively to our new challenge. For example, the Presidential

Commission and NASA have identified several problems and they have identified several corrective actions. Success in resolving these problems must extend across the board. The solutions must involve the Space Transportation System as a whole, including payload and facilities in space. The proposed solutions must examine every aspect of shuttle operations, including turnaround times, productivity enhancements, and the need for a new orbiter.

If we don't succeed, then our nation (and the free world) will be driven back to an overwhelming reliance on expendable launch vehicles. In my opinion, we will then have taken a major step backward. Without the Shuttle, we will revisit the sixties and the seventies and we will have failed to capitalize on the tremendous opportunities that the Shuttle program presents in improving the quality of life for all mankind.

The Challenger tragedy has not been our only recent launch vehicle system failure. As we all know, our space program has been further crippled by two Titan accidents and the failure of an "old-reliable" Delta; the European space effort has suffered the loss of an Ariane rocket. Although some of these were recently manufactured vehicles, there is at least one common link to these failures. The problems (that we are aware of) have all occured in subsystems that represent older technology. The solid rockets, the electronic components, the mechanical designs are all representative of 1970 technologies and not of what we can do today.

There is a lesson that can be drawn from the Commission Report. That lesson is that we must continue to invest people and resources into research and the creative process of implementing research results into new and safer designs, improved methods of testing and quality assurance, and most of all, in allowing our talents to be used to their utmost.

It is not enough to assume that because a machine worked properly before that it will work properly again. If the machine fails, it is not enough to assert that a management fix is all that is required to correct the problem. Ladies and gentlemen of this important committee, everyone of you, everyone of us has the challenge and the responsibility to not merely fix blame, but to provide every possible measure of support to NASA and the vital space program. First, it means a fundamental appreciation of the cadre of pioneers who have built a part of our national space program that has been the pride of America and the world. Second, it means that we must provide the resources to restore the space shuttle program as well as to broaden our expendable launch vehicle fleet . . . and this means investment in modernization as well as buying more of the same. Third, it means that we must provide a declaration of support for our space programs, one that acknowledges that all of these programs contribute to a better quality of life on earth. This would be in the spirit of our Challenger pioneers and it would be the bond of faith with future generations.

Mr. Roe. Well, I thank the General for an excellent overview, an excellent statement.

As you know, the committee has been pursuing this matter in three directions, and hopefully we are coming down to the end of our review. We have been looking at the detailed technological factors relating to the accident per se, which you touched upon in part in your statement.

Second, which you have also spoken to at some length, is the management and communications issues involved within the organizational structure itself.

Third, which is probably the most important one, is to see what our both short- and long-range policy is going to be, because that is the engine that is going to drive what steps will be taken by the executive branch and the Congress, as we see it, to get you back to where we should be in the Space Program.

Now, having said that, I think it would be profitable if you could expand further. In an interview you gave to the Presidential Commission under the date of April 18, 1986, which I thought was a very adroit interview, pointing out your observations as to management problems, on page 11 of that report you made the point that, and I quote, "I was appalled when I got there"—meaning your assignment to NASA—"to see how tough it is to get operations between Marshall in one, Johnson in one, the Cape in one." The Cape gets caught in the middle, but that is another one.

Then you go on to say, further down—it is very interesting to me because if level two, as we go through this thing, is still a problem—you speak to level two. "We worked very hard with what we call the level two organization to make that work; but since it wasn't working the way I wanted it, I spent a lot of time personally down into the bowels of the organization. We were going into the astronaut office and working with those guys, too."

Give us your observations. We see the management issue to be a very important one, and particularly with the interchange of the information it is now a vast organization. You have four or five different major centers, and hundreds, if you like, of hardware producers and manufacturers.

Would you explain a little further what your observations were? Is it because you were there that you gave your personal attention, at every level?

I noted you were at the Cape when they launched, and you were back to California when they landed, and you were actually dynamically with it all along the line.

Has some of that dynamicism been lost? Is the organization too big and too inflexible to be able to apply modern management techniques, or what should we be doing in that area?

General Abrahamson. I am not sure that there is a rulebook answer for that, sir.

It is true that when any organization is formed, it is formed to help you accomplish a particular task. By the same token, once it is there, it develops momentum and procedures and impediments, sometimes, to exactly what you would like to have, a dynamic and modifying organization for the challenges of the future. That is always difficult.

I believe that we had an organization that was designed for the development of the shuttle, and when we got there, since it was only the second flight, that we had a tremendous change of attitude that we had to be able to create, and that was to create an organization that would think in terms of operations of the shuttle and overcome the flight test problems.

I would like to emphasize flight test, because this is and will remain for actually the life of the shuttle, if you compare to an aircraft flight test program, a very different thing than I think some of the expectations were. In an aircraft program, we never consider that the machine is operational in terms of seizing flight tests until perhaps 300, 400 flights; and then we begin to take the first operational squadron for a military aircraft, or we begin to put in service the first operational airliner. So, we have many hundreds of flights.

However, that wasn't possible for a spacecraft program with such a small number of flights. What we had to do was continue what is essentially a flight test program at the same time we were conducting an operational program, operational in the sense that we were carrying productive payloads; not that the flight test risk had gone away. So, therefore, we had to, in fact, change that development attitude into one that was dynamic and responsive to this flight test challenge. That was difficult.

I had some luxuries during my time in that we were not scheduled with missions as often as came later on, and that allowed us, in fact, I think, to spend more time—it allowed me opportunities to work at all levels personally in the organization. That, obviously, had to be another change that had to come after I departed when the flight rate began to get much higher.

Mr. ROE. What I am trying to develop, so that other Members can build on it, is that you stated in your statement that the commission, as I recall it—you came back and said there are two things that have to be recognized; I think you reiterated that today: that the Space Shuttle Program in effect is still a R&D program.

General ABRAHAMSON. Yes, sir.

Mr. ROE. You mentioned in your testimony before—you said, well, when we were looking for the hydrogen leak, that gave rise—that dynamic gave rise to a review, a host of other anomalies we had to get into, and help resolve those other problems as we went along.

So, as criticality items become understandable, if you like, and as you attacked the criticality items, and so forth, that spread out, that technology kept spreading out, and improvements going on, and so forth.

I remembered also in your testimony when you mentioned they took the covers off some of the mechanisms of the shuttle system, that you were shocked and also appalled as to what was under those covers, as I remember it.

I just want you to know I reviewed your testimony quite thoroughly.

General ABRAHAMSON. Thank you, Mr. Chairman.

Mr. ROE. You make a very important point, because I think the management issue becomes important to this body. You mentioned

if we are still talking about R&D, and we are talking about the future, the short-term future of the Space Program, is it fair, from your observation, to say, yes, it is truly still R&D as we go along, and we improve and we do our criticality—you improved the engines, as I recall it, redesigned them completely, and so forth.

General ABRAHAMSON. Yes.

Mr. ROE. So, we are constantly upgrading the capability of the shuttle per se.

Is that a fair commentary to make?

General ABRAHAMSON. I think that has to be the attitude and the perspective on the Shuttle Program, because even after several years—remember, at the time of this flight we had 25 flights essentially, and that is—if you take an airplane, if I take the F-16, for example, which I was responsible for, at 25 flights we had just barely begun to explore the envelope and the performance of the machine. That is a technology we understand.

We have built dozens and dozens and dozens of airplanes. We have only built one space shuttle.

Mr. ROE. Let's build on that now. Let me say, well, if we recognize we have this space shuttle, and the only way we are going to be able to test it is literally fly it, therefore we find these different anomalies and problems as we go along. So, we are still in R&D, really, essentially.

General ABRAHAMSON. That is correct, sir.

Mr. ROE. Then, the second point—now I get to management—the second point comes back and says, yes, but then NASA, somebody in NASA, made a command decision that now that we have the shuttle constructed, we ought to provide a different mechanism of management so that we can get on with the operation of the system and not the same type of research approach we were taking before, vis-a-vis flying airlines, that type of thing.

We are now on a payload situation, and we are going to go ahead and fly, and we are going to be out there with a different coordinated team. They entered into the concentrated contract, if you remember, the consolidated contract down there.

Some members have testified—some of the different people who testified said they felt, the manufacturers, when that management system was decided, that they felt left out; that they didn't feel they were able to reach into the management people as they did before. With that new method of approach, sort of the airline approach, we are going to go out and fly on a schedule now.

Do you understand where I am coming from?

General ABRAHAMSON. OK. I understand that.

I would like to comment on that, sir.

Mr. ROE. Was the decision that was made finally, in the operational, coordinated operational—did it go so far that it did cut out communications and kept the manufacturers and kept many of the key officials from knowing what the facts were?

General ABRAHAMSON. I don't believe that was the case, sir. In fact, when the consolidated operations contract was conceived and put together down at the Cape, which of course was the first of those, the one major exception to the full consolidated operation was the mating of the solid rockets. That was retained at Thiokol. That responsibility was retained in that contract.

I am sure that there may have been a feeling—and I can't counter those who honestly felt that they didn't have that full access—but the system, as such, I don't believe relieved them either of the authority and responsibility to make inputs, and to make those inputs timely and correctly for the entire launch or for each launch.

Mr. ROE. Where I am trying to come from is—I respect your opinion, of course. But every one of the key manufacturers that testified that day came back and said the same thing—that both individually and as a group that they felt when that change was made that they lost part of the continuity and part of the response, as far as their ability to be able to participate. They felt that way.

Now, whether it was that they felt that way or whatever, that is what they said.

General ABRAHAMSON. I am sure they did, but I would like now, since I am supposed to comment on the Rogers Commission report——

Mr. ROE. Right.

General ABRAHAMSON [continuing]. That the Rogers Commission report did not comment and say that the cause of this particular accident was related in any way to that particular——

Mr. ROE. Nor am I suggesting that. The Rogers Commission report went further and said the preponderance of their attention was directed to the accident and what happened. But they brought up a number of peripheral recommendations, and one of the strongest recommendations they brought up was management.

General ABRAHAMSON. Yes.

Mr. ROE. You recall that.

I am just speaking to the general point of management, not in any way trying to say the management issue alone was responsible for this accident, because it was part of it. But it wasn't the whole thing.

You make one more comment, and I will follow up on some of my questions, but I want to follow the continuity. If you are speaking to the point of view of now we have got a flying machine, such as the F-16, unquote, we can now increase the number of flights involved——

General ABRAHAMSON. Yes.

Mr. ROE [continuing]. And we feel we will set up this management program. We can expedite it, run smoother, so forth, and so on.

On the other hand, we kind of got apples and bananas here. On one hand, we are saying it is an R&D program. Really, we are not that far. And yet, was the attitude such we will have to boost up these flights even as we go along, check our safety, anomalies, and so forth; now we are going to increase the number of flights that are involved, considerably so, as to what was originally planned.

It seems when you start looking at some of your own testimony and others' relating to the sand storms and the problems, and the rain storms that were involved, and different landing sites, and so forth and so on, do you think that pressure was too great on the NASA management system at that point, or were expectations too high? Were we trying to do too much in too short a time?

General ABRAHAMSON. During my tenure, I did not feel that that was the case.

Mr. ROE. You didn't have as many flights, either.

General ABRAHAMSON. Pardon me?

Mr. ROE. You didn't have as many missions, either.

General ABRAHAMSON. No, sir. I was there and was responsible the 2nd through the 13th mission. At that point, we not only dealt with that part of the program, actually the subsequent planning for future flights had been dramatically reduced, I think, back to a much more realistic scale than what was planned and talked about when the Shuttle Program was first conceived. It was considered to be truly, I think misunderstood, that it would be an airline type of operation.

That didn't mean that we shouldn't have a goal of getting those flights off on time, properly, and as quickly as possible and as effectively as possible, but never with the attitude that one would compromise safety.

I remember very well some of the derision that we got in the press in those early times when we would slip the flight or slip the flight for that for some of the various technical problems that we had, but we did it. It wasn't a matter of overresponding to the press. It was a matter of solving the problems and running this balance between having to fly in order to understand the machine and the capability of the entire system, at the same time insuring that we would fly safely.

Mr. ROE. But part of the driving force had to do with the economics of the system, too. In other words, I am thinking to the ongoing agreement between the Air Force and NASA as far as military satellites are involved. I am thinking about funding coming into NASA, in effect acting as a contractor, so to speak, both for national and international interests, selling their services, which they were directed to do.

General ABRAHAMSON. Yes.

Mr. ROE. I am just wondering if that kind of pressure becomes so great that it hurts in the Safety Management Program—in other words, if we don't get launched, we are not going to finish those. Therefore, the funding that is coming into NASA to keep NASA going, and the things we are doing in NASA, could be curtailed. We would have to cut back some place along the line, which I think gave rise to that attitude vis-a-vis the testimony we had on cannibalization of parts from the different orbiters, the fact there weren't enough spare parts to go around, and so forth.

I am just trying to generate, in your own thought process, as if our expectations were too high and we had other things driving it, the financing of it, the communications in it, would Congress provide the funding, did we have to go to the outside to raise funds to be able to keep us going, we pirated parts, we cannibalized parts, et cetera.

General ABRAHAMSON. I believe—again, if I can go to my period—and obviously some of that can be extrapolated afterwards—we clearly had in the early flight phase, when I was there, a tremendous shortage of spare parts. We had not understood or anticipated properly or funded in the early years, which was prior

to the first flight even, a proper bank of spare parts in order to run the program.

So, in that sense, yes, it was clearly underfunded. We came back and increased in our budget requests every year the amount of spares.

In addition to that, we asked for—I specifically asked for an engine improvement program where we had a three-phase improvement program for the engine, which I thought at that time was going to be one of the major, major problems, and clearly still is a major problem. So, yes, it was underfunded.

Now, were some of the factors of that underfunding, a concern generated by you that we had to have an income source? I think that is a subjective judgment. It is hard to make. However, I do believe that the funding concept, the industrial funding concept that was implemented, was not the kind of a funding concept that provides confidence and support and consistent forward planning that would allow you then to say I know that I can properly invest in spares at a time that will keep the production lines open, so that you can have those spares at a time that is consistent with your increased flight rate.

The investment in spares that we were trying to make in my timeframe was to make up for the shortages in the beginning, as well as to lay in spares for the subsequent phases when the flight rates would go up. There was difficulty.

And I believe that if you consider a policy change, one of those policy changes should be in the area of the industrial fund concept. I think you need to provide constant planning and a constant source of funding over a period of time so that there isn't—is not the pressure of trying to sell, because obviously you want the program to be productive.

Mr. ROE. That is precisely the point I am coming from, from management, because that, to me, is all management. For example, the committee has held hearings going back some time—if my members will forgive me, I think this is an important line we want to get to—where they really not only encouraged, but put pressure on NASA to buy the spare parts and get the spare parts. But, for some reason or other, that just didn't happen. That, to me, has got to be a management problem.

You go back to your time and your phase—and, believe me, this is purely clinical, nothing to you personally—if you look at the time, decisions in management have to anticipate how the business is going to run, I would think.

General ABRAHAMSON. Yes.

Mr. ROE. Then the question is, Congress felt it was very generous and excited about what was being done in NASA in our Space Program, and we are not pecuniary in providing the resources.

I don't see any great fights, at least in my time here, on the floor of the House, where people said, well, we will cut NASA back, cut NASA back, cut NASA back. Quite the converse. So, something between the beginning of the program and the dynamics and the excitement and the safety end of it, until we progressed, as the program, quote, unquote, begins to mature, some either attitudinal or management relationship to foresee what was down the road, to

understand what we needed to—the expectation of this program is lost.

That is, I think, what the commission is saying, and that is what we are trying to explore. We are not trying to blame anybody. We are coming back and saying if we go to the Congress and say yes, we need that fourth orbiter, we need it for these reasons, and so forth, we have got to be able to stand on that floor and say here is what is happening, and here is what has happened, here is what has been corrected.

We hope to call Director Fletcher back again to talk—he has given us a 30-day report to the President, as you know. OK, now let's go.

What are we really doing in management? Have we scrapped the idea of an airline approach? It is not an airline. It is an R&D vehicle.

I will go to the last item which is an item you mentioned in your direct testimony here. You spoke of older technology. We have had people who have testified, including some of your colleagues. They have said they did not feel we were dealing in antiquated technology.

One school of thought goes as follows: Here is antiquated technology, 1960, 1970 technology. Should we take a whole redirection now and go to the Orient Express approach, or however we take it, a whole new thing, slow down the program, not build the fourth orbiter, get this thing—let's get a new method going and a new flight system?

Some people come back and say, well, that is not really true, in their testimony. They say we have been, as you indicate here, upgrading, as we found these problems; we have been correcting them as we have gone along, and we are really not truly dealing in 1960, 1970 technology.

Now, to bring it full circle, you come up and say the problem—quote, the problems we are aware of have all occurred in subsystems that represent older technology. The solid rockets, the electronic components, the mechanical designs, are all representative 1970 technology, and not of what we can do today.

Now, I would like to have a little dissertation on that, if you can, because that approach is going to determine what our short-range solution is; how do we get back into space with inventory and intelligence and the military, and so forth. How do we create a balanced system? What do we tell the Congress they ought to be doing in the first thing, short-range policy?

General ABRAHAMSON. In terms of—I believe, contrary to what the others may have said, that in fact those systems are, in fact, older designs. They are built on older margins of safety, older mechanical concepts, O-ring seals, those kinds of things. Those concepts were devised in the early 1970's and are still inherent in these vehicles.

At the same time, you should not throw away the safety record or the working record of some of those particular kinds of systems. But we are making advances in technology, and I don't mean by that that we ought to not build a fourth orbiter or not, in fact, build more Deltas or use our resources that we have and the record that they have. We should.

But, what we should do is, we should use our advanced capability to insure that those systems work right, or to correct where they are weak.

Let me give you some examples. Some of our greatest advances in technology that I am seeing in the strategic defense initiative and in other areas are in quality assurance, new techniques to examine machines that see that the quality assurance is right and correct.

While I was in the Shuttle Program, I was very worried about the external tank. The external tank was the only component that we did not get back every time. And because we didn't get that back every time, we didn't have the luxury of being able to use postflight analysis properly to pinpoint and look ahead to see problems that were coming ahead.

In making the external tank, one of the major problems is automated welding, welding of aluminum structures. While we were there, we could see that, using human beings there, introduced human variability into that process. So, we added automated welding processes down at the mission facility, and they have made a great start, and they are doing well.

But right now, today, up at the Idaho engineering laboratory, I saw about a month and a half ago new techniques for insuring that automated welding—that you can maintain the highest level of quality control, new techniques for it, being able to document that quality, being able to measure the puddle itself as the weld develops, techniques for being able to measure the depth and the temperature penetration.

The first thing I did was to say that technique ought to be brought to NASA's attention, and, in fact, I called people at NASA worried about exactly that. So, please do not misinterpret my plea for new and better technology for only abandoning all of the old, because then we will never have a short-term solution.

We have to come to a practical, short-term solution. But there are new kinds of techniques that will help us to make that older technology work and to be more effective.

The Titan failure, one of them occurred because of one of the seals that was over the solid rocket propellant. The inspection technique for that was no different from the inspection technique we have used for years and years and years.

We now have new techniques, ultrasonic techniques. We have many, many techniques that we can use and apply to insure that those kinds of things work. Now, that requires an investment in both research, for some of these new techniques, and then an investment in capital spending, to bring that technique available and to bring it to bear on the manufacturing line. That is what we did on the engine.

When we found the welding problem I talked about and the quality assurance project at Rocketdyne, I went back to Rocketdyne and said, "I want you to invest in new automatic welding equipment, and I want us to see if we can understand"—and perhaps I overstated a little bit—"a national welding initiative."

Whoever heard of a national welding initiative? That sounds very prosaic. But it was important.

And now, if you go to Rocketdyne, you will see that that company and the machinery that is there—and it took several years to implement it, by the way—but is a completely different approach to the fundamental way in which the engine was manufactured for the first engines, and back when we were working the engine problem, the welding issue, which had many, many unknowns, and we were on the edge of what a human being can do, but that the design required.

So, we made that investment. We made it then, and it has made a difference now.

We also invested, through the Science and Technology Program at NASA, in improved parts for the engine, and that is now being implemented. They are not all there yet, but there has to be an investment to buy those new parts for the future.

So, when I talk about new research, and applying those, I am not advocating only that we go to a futuristic system. By the way, we might have to do that as a nation, too. So that means that there is a requirement to invest in research. In fact, that is what makes our Nation work. That is why our capitalistic system works in the private economy, because people do make those investments.

Mr. ROE. Does the gentleman recognize there is both a short-range policy decision to go through and a long-range policy?

General ABRAHAMSON. Yes.

Mr. ROE. The Chair recognizes the distinguished gentleman and our minority member from New Mexico.

Mr. LUJAN. Thank you, Mr. Chairman.

General, following up on this business of new techniques and new and better ways of doing things, I also, you know, was looking at your statement and talking about older technology. You mentioned the O-ring situation, and that has been around for a long, long, long, long time. Not that those of us who have been here for a long time don't feel just because something has been around for a long time you ought to get rid of it, but you ought to be analyzing it.

What I get from a lot—visiting with people—is that there are better ways, better ideas of building those solid rocket boosters rather than this O-ring situation.

In your SDI experience, with such forward-looking technologies that you look at, do you feel there is a different way of doing it?

General ABRAHAMSON. Yes, sir, I have. I have not studied the joint particularly in great depth, although I have seen some alternate near-term fixes that NASA has talked about, and in fact, I have given my opinions about some of those.

I do know that the agency—and obviously Mr. Moore and NASA officials should comment in detail—has looked at a whole range of different designs, but I think we have to go further than designs. We have to ensure that we apply the technology to the manufacturing process to ensure that those designs will not only remain safe in the short term, but in the long term as well.

Mr. LUJAN. Let me ask you what you mean—maybe you can expand on it. It says, "The program manager by definition has the necessary authority to get the job done. What the program manager must ensure is that the program objectives do not get blurred in transmitting them through OMB and through the Congress."

What does that mean? Give me some examples.

General ABRAHAMSON. I think actually the chairman illustrated that and what I am trying to illustrate, that you must always keep the flight safety requirement foremost, and that the desire to continue to be able to fly on a schedule and to fly to support the operational side of the program is always there.

Mr. LUJAN. That was the discussion you had about spare parts and all that?

General ABRAHAMSON. Yes.

Mr. LUJAN. I wondered about that every time that question of spare parts comes up. Since I have been on this committee, I don't know that we have ever said no to NASA, just about. NASA has gotten everything that it has ever asked for and the figure of $40 million keeps going through my mind as most of the time we are providing $40 million for the Spare Parts Program.

That being the case, I always wonder when we are told that 20 to 30 items are cannibalized from another engine, from another shuttle each time there is a flight, and as a matter of fact the other day the testimony was that all of the vehicles have parts missing from them, that if you were to fly one now, you would have to go cannibalize another—how can that be? Forty million dollars is a lot of money and if we are looking at buying spare parts over the years at a rate of $40 million a year, it just seems like an incredible situation.

Was that the case—well, you didn't have that many when you were managing.

General ABRAHAMSON. We increased the spares budget, but spares are lots of different levels of spares; $40 million is a lot of money if you are going to buy a lot of washers and seals and bolts and nuts and things like that. On the other hand, for a rapid operation that can safely be conducted, you have to have a higher level of components that you can interchange.

You have to have full computers ready to go and go in place. You must also have, in some cases, for example, the pods on the back of the aircraft, and finally, we implemented the Structural Spares Program during my time that I was there because I did anticipate that at some point we might ding a wing or do something like that.

I never anticipated that we would have a tragedy of this kind where we would lose the whole orbiter, but I wanted to have at least structural components available.

Mr. LUJAN. If $40 million is the figure that we do every year, that that apparently is not enough; that more—I am not asking for a budget recommendation, but what has been done before is not sufficient to keep up with the problem——

General ABRAHAMSON. I believe so.

Mr. LUJAN. Was that the case when you were there?

General ABRAHAMSON. I would have to examine the whole program, but when I looked at it when I was there, we did not have a sufficient budget in spares and therefore we increased those. That has to be examined very carefully and calculations made about what the cost benefit is. Sparing for a very small fleet is a difficult problem. You must in fact invest at higher levels and have higher stockage levels in order to handle that.

For a large fleet of airplanes such as the airlines have, you can afford then to have many on hand or several on hand, even if they are not used much, because you are amortizing that set of spares across a larger fleet.

So you must look at the small fleet problem in a different way than the large fleet problem. I think that there will probably always be some level of this cannibalization.

By the way, that occurs in every airplane fleet and it probably occurs on the airlines that you and I fly on, too, so you should not lose that perspective.

On the other hand, an excessive level is not the way to conduct an efficient operation and it can impact safety.

Mr. LUJAN. One quick and last question. Do the needs of SDI require a fourth orbiter if we take into consideration the type that we need, maybe doing commercials on ELV's? Do you need a fourth orbiter for your work?

General ABRAHAMSON. First of all, SDI by itself does not require more than an operating capability of the space shuttle. But I believe that the Nation requires a fourth orbiter.

Mr. LUJAN. I don't understand your answer.

General ABRAHAMSON. The number of flights that SDI will have over the next few years are not so excessive that those flights by themselves exceed the three orbiter flight requirement.

Mr. LUJAN. No. I mean that plus building a space station——

General ABRAHAMSON. But in the sense that you ask the question, yes, sir, my personal opinion is that we do need a fourth orbiter. In order to have a viable fleet and in fact that was one of the reasons that I invested in and proposed the concept of the structural spares, so that that decision could be made.

Mr. BROWN. Would the gentleman yield?

Mr. LUJAN. Yes.

Mr. BROWN. I think General Abrahamson is making a point here which I have heard him make before; that SDI is a research program per se and does not require this capability. I think what we need to ask, in the event a decision is made to deploy a space-based defense system in the mid-1990's, what kind of space transportation system would it require?

General ABRAHAMSON. Sir, that is, of course, a very different question. What is required, a fourth orbiter will not handle that and I think that is the key point. Then it is a much larger space transportation requirement and in fact that has been studied now in a three-agency look at the program with NASA and with the Air Force representing the rest of the Department of Defense and SDI representing our own view of what those requirements might be, and it is clear that the requirements will exceed a four-orbiter fleet, but the characteristics of those requirements may also mean that you have to have a fleet of unmanned rockets of different sizes, and even potentially in the future maybe the aerospace plane as one solution to that.

So that recommendation has been presented to the President. The important role that the SDI Program plays in that is that we are conducting and financing at least a portion of the research to ensure that whenever that decision is made that we will have a much lower cost option available to the Nation.

64-548 O—86——8

So that is what we think is a proper role for SDI research in space transportation.

Mr. LUJAN. I didn't want to ask any more questions, but I can't let you get away without asking if you paid for a little bit of the shuttle, if you put up a little dough for the fourth orbiter?

General ABRAHAMSON. That is a policy decision that goes beyond me personally.

Mr. LUJAN. That is all.

Mr. ROE. The Chair recognizes the distinguished gentleman from New York, Mr. Scheuer.

Mr. SCHEUER. Thank you, Mr. Chairman.

General, we value your testimony. You have been an extremely impressive witness. I have enjoyed it and I have benefited from it.

General, the Rogers Commission found that, and I am going to just quote a sentence, the Marshall Space Flight Center Project Managers, because of a tendency at Marshall to isolate—to management isolation—that is a euphemism for saying they didn't want to listen to anybody else. They fail to provide full and timely information bearing on the safety of the flight 51-L to other vital elements of the Shuttle Management Program.

Do you more or less agree with that?

General ABRAHAMSON. Well, I didn't conduct the investigation, sir, and obviously there was a communication breakdown, and I am sure that that communication breakdown occurred at several different places. One of the important thrusts of my testimony was to point out that when I was there, although there were difficulties in communication across all of the institutions as there always are in these large institutions, that what I saw were people who were dedicated to flight safety and dedicated to making it work and we all worked very hard, starting with myself, with Mr. Beggs as the Administrator, Hance Mark as the Deputy. All of us worked very hard to ensure those communication lines remained open. In this case, obviously it didn't remain open.

I am not in a position to say that I know how it broke down.

Mr. SCHEUER. But this kind of situation didn't prevail through your tenure at NASA?

General ABRAHAMSON. I did not feel that that was the case. I did feel that we had a hard time making a change in the—in this transition from institutions that were dedicated to development to working together fully and communicating fully, but that was not only one of the centers.

In fact, all of the centers—we had to learn to work these institutions that were well established, have them work together in a very dynamic way in order to ensure that we had——

Mr. SCHEUER. Do you feel at Marshall, from what you have read of the Rogers report and what you know of the accident, that they failed to learn, as some of the other space centers did, how to communicate effectively? Did they learn at other space centers how to handle problems such as the one that led to the *Challenger* tragedy better than they had learned to cope with it at Marshall?

General ABRAHAMSON. Well, it is clear that in this particular case there was a failure and the communications chain broke down at several levels and if I read the Commission report properly, one of those levels was at Marshall. However, again I would like to

point out, and if I can I really would like to focus on something very important for the Space Shuttle Program.

As the chairman properly pointed out, from my own interview with the Rogers Commission people, I was appalled when I first saw the shuttle, because it was anything but an operational machine. It was clearly going to be very difficult to make that fly and to fly successfully, because it was a technical challenge that was a huge step forward to have a spacecraft and an airplane and to be able to fly safely through all of those regimes.

However, I was encouraged by one important difference in the space shuttle than any other program, and that is that most of the shuttle came back and could be examined and reexamined and you could project trends.

Now, we tried to do that in the early times when I was there. We tried to pay attention, careful attention, to some very serious problems. It is also clear in the Rogers Commission report that in fact there were indicators that I believe should have been responded to much more aggressively and quickly.

Mr. SCHEUER. General, the Rogers Commission concluded that both as to Morton Thiokol and the night before the launch and as to Rockwell on the morning of the launch, NASA seemed to be requiring contractors to prove that it was not safe to launch rather than to prove that it was safe to launch.

Is this your reading of the Rogers report?

General ABRAHAMSON. Well, I understand what the Rogers report says, sir.

Mr. SCHEUER. If it says that, and I think it clearly does, this would run counter to your statement that at no time did you ever discover anybody who didn't put flight safety first and foremost in their considerations.

General ABRAHAMSON. That is correct.

Mr. SCHEUER. When you require a contractor to prove that the vehicle is unsafe, you are putting a lot of other considerations ahead of safety, are you not, on the priorities list?

General ABRAHAMSON. That is correct, sir.

Mr. SCHEUER. Why do you think this happened? From your knowledge of NASA, from the various space stations, how do you think this crazy involuted philosophy ever developed that resulted in such tragic results?

It is always easy to be a Monday morning quarterback, and we really shouldn't. We ought to restrain ourselves from doing that in an excess of zeal, but every member of this committee on both sides have been appalled at that new burden of evidence that was established that the safety engineers at Morton Thiokol and Rockwell now had to prove that the vehicle was unsafe.

We are appalled at that. That is in such glaring contrast, such pitiful tragic contrast to the status of NASA as you described it, that one has to wonder how did that happen.

Can you help us understand? How did that change take place?

General ABRAHAMSON. Frankly, I am not sure that I can, but I can offer you an important perspective, and this comes from not only my experience at NASA, but my experience being in charge of other flight test programs and participating as a test pilot in those programs.

These are never simple black-and-white decisions. There are always differences of opinion, and in fact, the success comes from those who are able to successfully walk that very difficult line that I talked about.

It would be a great tragedy if somehow out of this, this particular accident, a system is established so that one person, who may or may not be right, can stop everything by saying, "Woops, I am worried about this particular thing."

And, by the way, there is a very real danger that that can happen. On the other hand, the fact of the accident and the fact of the communications breakdown, and the fact that there were valid and important opinions that did not get all of the proper hearing that they should have, also means that that communications process must be improved, just as the Rogers Commission report outlined.

But those are never simple kinds of decisions. Every one of them—and I guess I would like to make an important point——

Mr. SCHEUER. Let me interrupt you for one second. It is true there were some communications breakdowns, but it is also true that right up to the top of headquarters one in Washington, NASA was aware that the safety engineers of Morton Thiokol had the gravest doubts about the safety of the O-rings.

So while the Marshall officials weren't doing much to let that information out, it sort of perked through up and down with difficulty. Weeks did brief Moore on the briefing that he had in August 1985 by the Morton Thiokol engineers that indicated their grave reservations about the safety of the O-ring.

The communication was there. It was a judgmental factor. It was this reversal in the burden of proof.

You have told us you can't understand how it could have happened. Frankly, we are at a loss to understand how it could have happened. The American people must be absolutely flabbergasted that it did happen.

My last question is, how can we avoid that again? How can we make sure that never ever does an official of NASA twist arms with contractors, ignore the pleas of safety engineers—there was a consensus among safety engineers, it wasn't one isolated voice out of the wee, small hours of the night. It was a consensus among safety engineers that there was a life-threatening condition here.

How can we avoid in the future an institution that ignores these kinds of concerns and that makes judgments that puts safety and completion of the mission safely so far down the priorities list?

General ABRAHAMSON. I wish that I could give you a simple answer to that, but I don't believe there is one. I think the Rogers Commission made a series of recommendations about elevation and separation of the safety and the quality assurance organizations.

I think that those are proper. I believe that that will help, but it won't help automatically, and it won't be an automatic answer. There just isn't an automatic answer, unfortunately, but I do believe the recommendations are correct. But in the end, it relies on people doing all of those jobs and the difficulty of communications across a very large number of people, and I tried to include in my testimony that the right atmosphere for that must be created.

Mr. SCHEUER. General, Thank you very much.

Thank you, Mr. Chairman.

Mr. ROE. The Chair thanks the gentleman from New York and recognizes the gentlelady from Kansas, Ms. Meyers.

Ms. MEYERS. Thank you, Mr. Chairman.

I think you are probably aware, General, that there is a move in the Armed Services Committee to divert half a billion dollars that the Department of Defense is obligated to reimburse NASA for military launches.

What is your thinking on that? Would you support that kind of a diversion in light of what you have said about consistent funding for NASA?

General ABRAHAMSON. Ma'am, I would not support that. I think that the greatest need that NASA now has in order to be able to plan for and implement solutions in a timely way is to be able to have a fund, which obviously was never planned for, and as this committee and other committees last year went through that budget, no one anticipated that this terrible accident would happen.

Therefore, NASA did not have a margin in order to be able to deal with that, to do the testing, to do the investigation, and if—and I recognize Congress has difficult priorities that you must deal with, and I respect the problems that you are all facing—but if that one area, which is money that can be diverted and used in the near term, is taken away and not replaced quickly and with flexible funds so that the managers can apply that where it is needed, then I think NASA will be in very, very serious difficulty, and, in fact, I know they are, because I have talked to NASA officials at all levels.

And the uncertainty associated with how they are going to fund not only the investigation but the next steps is a major factor in their inability to proceed at this point in time.

Ms. MEYERS. Thank you.

Mr. Chairman, I have one other question if we have time before the vote.

I think one of the interesting—most interesting points that you made was when you said that the problems that we are aware of have all occurred in subsystems that represent older technology, the solid rockets, electronic components, and mechanical designs are all representative of 1970 technologies and not of what we can do today.

Can you redesign these older technologies or does this mean that we will have to just start from scratch on the next generation?

General ABRAHAMSON. What I was trying very hard to get across is that in the short term there are technologies that we can apply to make those older—the fundamental designs that we have now today, to make them safer and more reliable, and that is why I was emphasizing the kind of technology applications that apply to production line and quality assurance.

In the longer term, we should, of course, look for more reliable fundamental designs based on the new materials and some of the new concepts that we have.

Ms. MEYERS. Thank you.

Mr. ROE. The Chair thanks the gentlelady from Kansas.

We will recess now to go vote. I would ask the members if they could return immediately, because the general has to go on to California, I understand, so we will return immediately after we vote.

[Recess.]

Mr. ROE. The hearing will reconvene, and we will—the Chair will recognize the distinguished gentleman from California, Mr. Packard.

Mr. PACKARD. Thank you, Mr. Chairman.

General, it is nice to have you here before us. We are about to conclude our hearings, I think. We have had a long series of hearings and your testimony has been very effective.

I am sorry I wasn't here to hear your verbal testimony, but I have read your written testimony. You mentioned in an answer to an earlier question, and from that answer I have to assume that the Shuttle Program is extremely important to the SDI Program.

General ABRAMSON. That is exactly right, sir.

Mr. PACKARD. As well as other programs, the Space Plane and our ELV program and what not.

Do you think that it is going to require a better balance between the ELV's and the shuttle than what we have had in the past in order to meet the needs of SDI?

General ABRAHAMSON. Yes, I believe that the Nation has to have a better balance. By the way, when I was in the Shuttle Program, I was concerned that the Nation would not learn how to use the capability that the Shuttle Program had and offered, and therefore, I used to press very hard for the shuttle.

But I think it is also clear in retrospect that we do need a balanced program, and that some vehicles will serve some needs and other will serve others.

The shuttle is an ideal research tool. It is an ideal scientific tool and in some instances it works very, very well for bulk transportation, but it won't serve all of our bulk transportation needs.

Mr. PACKARD. Do you agree, generally, with the recommendations of the Commission's report?

General ABRAHAMSON. Yes, sir; I do.

Mr. PACKARD. All of them?

General ABRAHAMSON. I think what they have specifically outlined is a proper series of recommendations for management that I think are exactly correct.

Mr. PACKARD. And, therefore, do you believe that implementing them will solve the problems that led to the accident?

General ABRAHAMSON. I don't believe that there is any automatic solution, but I do believe that those are the right steps that NASA will take the action so that, indeed, those steps will lead to a proper solution.

Mr. PACKARD. Do you feel that it is necessary to correct other long-standing weaknesses in the system—and I am talking now about hardware weaknesses, the shuttle motors, the landing systems.

Do you think those need to be corrected before we fly again?

General ABRAHAMSON. I think the people at NASA will make the right decision about how to do that.

Some things do have to be corrected. Some things are not going to be correctable.

Let me give you one example of one that worried me, and that I had special meetings with John Young and the astronauts and the people at Johnson and others, and that is the escape problem, the bail out problem.

We studied that. We went back to see, is there a practical way to do that. In fact, I went so far as to ask the people at Langley to develop a special report about whether or not the astronauts could bail out safely.

I don't know what the final answer to that is, but I recently was given a technical note that did explain exactly and was the result of my request, and unfortunately, the answer to that is that all of the astronauts, all sizes and weights of astronauts, could not bail out safely, so that means they have to have some additional means of getting out.

So, you will never be able to make this a risk-free operation, just like airport flying is not risk free.

Mr. PACKARD. Apparently—and your experience, I think, would be valuable in terms of answering this question—on the frontier of any program such as within your testimony piloting and early stages in the Shuttle Program and in the space program, are there always questionable and imperfect problems you continually have to deal with, and yet you still fly, you still go, recognizing that there are some weaknesses and some problem areas that need to be resolved?

Is it common that that is done, and in so doing, is there judgments needing to be made to determine whether those are life threatening and mission threatening or whether they are acceptable weaknesses and you still choose to fly? Is that true in most of these kinds of frontiers?

General ABRAHAMSON. It is clear the way you asked the question that you do understand and that is exactly the case, sir.

In fact, that goes beyond research programs and flight test programs. That goes all the way to operational programs and even airline flying today.

Those kinds of judgments have to be made every day, and there are people who have that responsibility, and I admire those people, because they accept the responsibility of life and death situations every day and they do their very best.

Mr. PACKARD. In your judgment, then, you feel that it would be unacceptable to require everything to be corrected and everything to be considered to be perfectly in order to fly again—that would require undue delay in getting back into our space program?

General ABRAHAMSON. It is not only a matter of undue delay for the Space Shuttle Program. Nothing is ever perfect, nothing.

And, therefore, you must arrive at a reasonable judgment, one that considers not only the risk to safety but the consequences of it, of any particular failure, and that is a difficult job.

Mr. PACKARD. Thank you.

Mr. ROE. I thank the gentleman from California.

The Chair recognizes the gentleman from Florida.

Mr. LEWIS. Thank you, Mr. Chairman.

General, welcome, and it is a pleasure to read your testimony. It is certainly very forthright and straightforward, and I believe in all of the words, both from the Rogers Commission and what I have

heard before this committee, I have never heard anyone make the statement that the problem with the O-rings was inexcusable, and I commend you for that.

Reading in the Rogers report, we have heard a lot of testimony— I am one of these people that believe the system is in effect, but we have humans in the equation, and you brought out that we are never going to be able to say, "it will never happen again" in this area.

I think Congress has some responsibility here, and I think we are arriving at a point now where we say, "Hey, what can we do to help get the Space Program back into an operational mode?"

What do you think Congress can do in order to do this job?

General ABRAHAMSON. I tried to outline that very briefly at the very end of the testimony. I believe, first of all, they have to understand and appreciate that there are people at NASA who have, in fact, suffered through this tragedy, as all have, but who are willing and able and continue, even in the face of sometimes adverse publicity, to want to make the program work. And I think those people must be appreciated, first of all.

Second, I think NASA must have the necessary resources to be able to use their engineering judgment and their management judgment and go out and invest properly in the program so that they can correct the faults and be able to ensure that this never happens again.

Second—or third, rather, I believe that it is important that all of us agree on what our national goals are and that we declare those properly and implement policies, then, that are consistent with those goals, and I think this committee has done that in the past. It has supported defining those goals, and you now have a special opportunity to help in the defining of those goals for the next phase in the program.

Mr. LEWIS. With the situation we had in—in the decision or judgment making process with the January 28 disaster, and believing that the system is in place and we have the necessary checks and balances, but with people remaining in some of those key decision-making positions, launch after launch, time after time, do you think that it would be helpful to rotate those people that would make those kinds of judgments?

And I say that because I remember a gentleman from NASA sitting here before us making the statement about whether to or not to launch, that he was very much concerned that he was going to have to go before a board of inquiry.

I think that should be, probably, foremost in anyone's mind when they are making those judgments, but at the same time if you have people that get into a position, they get into that niche, and the system falls down—and we saw that happen.

Do you think a rotation system would be more beneficial if we use the same kind of checkoff system? Because of the mass of systems, that you have to get into a good position to launch that shuttle, there is always going to be the fragmentation of human error.

General ABRAHAMSON. Sir, I don't believe that there is an automatic answer to that.

It is important to change people so that they—first of all, they can grow in their own careers, but more importantly, that they

don't become complacent and, therefore, there are times that it is important where they continue to have new minds and new eyes looking at some of the same problems. So, that is important.

By the same token, if an automatic rotation system were implemented, you may well lose some of the most important experience that is available.

I think the key here is that NASA management has got to be in a position to make those kinds of personnel decisions, and hopefully, the committee and the Nation will understand it properly and support NASA management while they make those decisions.

But I don't think that—there are no automatic systems anywhere, and thank heaven there aren't, because people are the things that make these systems work.

Mr. Lewis. I have one final question, and we have heard a lot of testimony on this.

Last August, there was a design review of the particular field joint that had a problem, and orders issued and a redesign was necessary.

What is your feeling about this, when we had our hands—had the problem in our hands and let it get away from us? What is your personal feeling about it?

General Abrahamson. Well, it goes back to my earlier statement that the shuttle does have particular advantages that any other system did not have, and that is that because you can recover most of it, then there are things that you can and should do in order to be able to project and see the performance of these systems.

It is, in fact, a place where complacency or faith in the fact that it had worked before was misplaced. That is clearly part of the problem.

On the other hand, the issue of how quickly and how best to make that change—I was not there at the time and, therefore, I can't say what was the right design change. I personally think that it should have been pursued aggressively.

Mr. Lewis. I recognize that, and I agree with you.

From an engineering viewpoint, the random numbers are going to up with a probability to tell you when you are going to have your failure.

I don't know why anybody wanted to fly on the 25th, because it said that is the one that could probably fail. That didn't happen, of course, but anyone flying on the next one, it will probably be the safest.

I appreciate the testimony.

Mr. Roe. Are there other questions?

General, we want to thank you very much for being with us this morning. Your testimony has been very helpful.

General Abrahamson. Mr. Chairman, thank you. I enjoyed being before the committee and I commend the way you are approaching this.

Mr. Roe. We now have our next witness, Mr. Jesse Moore, who is director of the Lyndon B. Johnson Space Center in Houston. Welcome to the committee.

You have your testimony, so you might just as well go right into it.

STATEMENT OF JESSE W. MOORE, DIRECTOR, LBJ SPACE CENTER, HOUSTON, TX

Mr. MOORE. Mr. Chairman and distinguished members of the committee, I am pleased to accept your invitation to testify before your committee today.

The Presidential Commission on the Space Shuttle *Challenger* Accident has completed its report and Dr. James C. Fletcher, our Administrator, on July 14, submitted to the President his plan for how we shall respond to implement the Commission's recommendations.

Dr. Fletcher in transmitting to the President our action plan to respond to the Commission's recommendations noted that the Commission had rendered the Nation an exceptional service in a comprehensive and thorough investigation and that NASA agreed with the recommendations and was vigorously implementing them.

Dr. Fletcher's statement to the President certainly speaks for all of us at the Johnson Space Center [JSC], as well.

I personally found the Commission's report to be an excellent effort in its comprehensive assessment of the recommendations related to the *Challenger* tragedy. Chairman Rogers and all members of the Commission are to be commended.

To assure that I, and all the staff at Johnson Space Center, are doing all that we should in a timely and comprehensive manner to support Dr. Fletcher and Rear Adm. Richard H. Truly in implementation of the nine recommendations, I have assigned a senior JSC staff member to each recommended action and I hold weekly status meeting each Monday morning to review our progress.

Dr. Fletcher, Admiral Truly, indeed all of us in the flight organizations agree that flight safety must be our top priority as we proceed toward the resumption of space flight.

The space shuttle is a national resource that has and will provide people benefits to this Nation and all mankind. Flight safety must not be compromised as we move forward.

The two items you have asked me to address this morning: the decisionmaking process and strengthening the role of the Program Manager are primarily assigned for action to NASA Headquarters, Admiral Truly's office, and our task at JSC is to support that effort.

Two study groups have been assigned to address these topics. On June 25, 1986, Admiral Truly appointed Capt. Robert Crippen to lead a factfinding group to assess the National Space Transportation System management structure including the Shuttle Program managers responsibilities and also to look at improved communications.

Mr. Richard H. Kohrs, Deputy Manager of the National Space Transportation System Program Office at JSC, has been assigned to Captain Crippen's team. Dr. Fletcher also has appointed Gen. Sam Phillips to conduct a broad assessment of every aspect of NASA's management practice. The results of the study will be reviewed with General Phillips and the Administrator, and a decision is expected by October 1, 1986.

To support both these efforts, I have assigned coordination responsibility for JSC's response to Mr. Clifford E. Charlesworth, cur-

rently Director of Space Operations at JSC and formerly Deputy Center Director of JSC and Deputy Director of the Skylab Program.

I make particular note of his seniority and experience to assure you that we have committed our best and most experienced people to the support of these studies.

I fully endorse the recommendations of the Commission and am fully committed to assuring that they are effectively implemented. I can assure you that this is not just my personal commitment but that of the entire Johnson Space Center, both its government and its contractor staff.

The Nation and, indeed, the world have experienced a grave tragedy with the loss of *Challenger* and its dedicated, brave men and women who made up the crew.

We must do everything we can to prevent a future occurrence. We must learn from the hard lessons *Challenger* taught us. We must emerge stronger and wiser as NASA and this Nation continues to explore space.

Thank you very much. This ends my formal oral statement, and I will be happy to answer your questions.

[The prepared statement of Mr. Moore follows:]

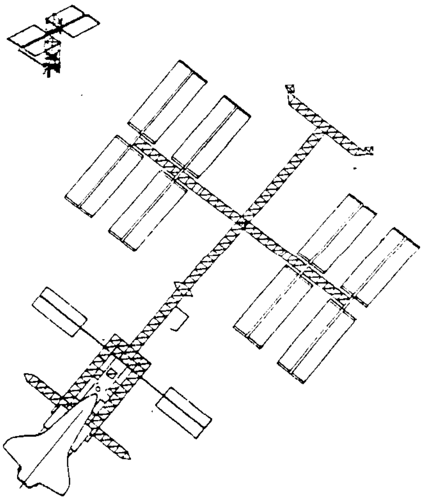
National Aeronautics and Space Administration

Hold for Release Until
Presented by Witness

July 24, 1986

Committee on Science and Technology

United States House of Representatives



Statement by:
Jesse W. Moore
Director, Johnson Space Center
National Aeronautics and Space Administration

99th Congress

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PRESENTED BY WITNESS

July 24, 1986

Statement of

Jesse W. Moore
Director, L. B. Johnson Space Center
Houston, Texas 77058
National Aeronautics and Space Administration

before the

Committee on Science and Technology
United States House of Representatives

Mr. Chairman and Distinguished Members of the Committee:

I am pleased to accept your invitation to testify before your Committee today. The Presidential Commission on the Space Shuttle Challenger Accident has completed its report and Dr. James C. Fletcher, our Administrator, on July 14, submitted to President Reagan his plan for how we shall respond to implement the Commission's recommendations.

Dr. Fletcher in transmitting to the President our action plan to respond to the Commission's recommendations noted that the Commission had rendered the Nation an exceptional service in a comprehensive and thorough investigation and that NASA agreed with the recommendations and was vigorously implementing them. Dr. Fletcher's statement to the President certainly speaks for all of us at the Johnson Space Center, as well.

To assure that I, and all the staff at Johnson Space Center, are doing all that we should in a timely and comprehensive manner to support Dr. Fletcher and Rear Admiral Richard H. Truly in implementation of those recommendations, I have assigned a senior JSC staff member to each recommended action and I hold a weekly status meeting each Monday morning to review our progress. Dr. Fletcher, Admiral Truly, indeed all of us in the space flight organizations agree that flight safety must be our top priority as we proceed toward the resumption of space flight in the Shuttle Program.

The two items you have asked me to address this morning: the decision making process and strengthening the role of the Program Manager are primarily assigned for action to NASA Headquarters, Admiral Truly's office, and our task at JSC is to support that effort.

Two study groups have been assigned to address these topics. Admiral Truly has appointed Captain Robert Crippen to lead a fact-finding group to assess the National Space Transportation System management structure including the Shuttle Program managers responsibilities. Mr. Richard H. Kohrs, Deputy Manager of the National Space Transportation System Program Office at JSC has been assigned to Captain Crippen's team. Specifically, this group will address the roles and responsibilities of the Space Shuttle Program Manager to

assure that the position has the authority commensurate with its responsibilities. In addition, roles and responsibilities at all levels of program management will be reviewed to specify the relationship between the program organization and the field center organizations. Dr Fletcher has appointed General Samuel Phillips to conduct a broader assessment of every aspect of NASA's management practices. To support both these efforts, I have assigned coordination responsibility for JSC's response fo Mr. Clifford E. Charlesworth, currently Director of Space Operations at JSC and formerly Deputy Center Director of JSC and Deputy Director of the Skylab program. I make particular note of his seniority and experience to assure you that we have committed our best and most experienced people to the support of these studies.

I fully endorse the recommendations of the Commission and am fully committed to assuring that they are effectively implemented. I can assure you that this is not just my personal commitment but that of the entire Johnson Space Center, both its government and its contractor staff.

Mr, Chairman, this is the end of my prepared testimony. I appreciate this opportunity to appear before you today and would be pleased to answer any questions you may have.

Mr. ROE. We want to thank you for your contribution and the Chair would recognize the gentleman from Florida, Mr. Nelson.

Mr. NELSON. I will pass, Mr. Chairman.

Mr. ROE. The gentleman from California.

Mr. PACKARD. Thank you, Mr. Chairman.

I just went out to call and get the staff to bring over the implementation plan that I have reviewed carefully and that you make some allusion to in your testimony. I had some questions on that that I didn't have in my presence, and hopefully, my staff will have it here before we are finished today.

But let me ask some general questions and then maybe the primary question I had, as I reviewed the implementation of the recommendation plan—did you sense or have you sensed in the past, Mr. Moore, any difficulty in communications from one center to another as you operated out of the Johnson Space Center?

Mr. MOORE. As I sat in the position of the Associate Administrator for Space Flight for about 18 months, I believe, I found that the center directors, which are mainly my line of communications with the centers, worked very well together and we had management councils to ensure that the center directors and the other people in the center would, in fact, attend the sessions and, in fact, raise questions and issues that could be brought up from knowledge of one element that had effect on another element of the program.

So, over all, I did not sense the kind of communication problem that was brought out in the Rogers Commission report during my tenure as the Associate Administrator.

Mr. PACKARD. As you have reviewed the Commission's report, and as you have evaluated the communication system, and being a very important part of that communication system in the past, after reviewing it, do you agree that there is or has been a communication problem in the system?

Mr. MOORE. I certainly think as a result of what the Rogers' Commission did in pointing out these communications, I would have to agree with Chairman Rogers that there is a communications issue or there was a communication breakdown in this one particular instance that really needs to be studied that is on the high-priority list for his group to look at and we strongly endorse that be looked at with great thoroughness to prevent these kinds of things from happening in the future.

Mr. PACKARD. Do you feel that can be done within the organizational structure as it has been recommended?

Mr. MOORE. I believe an approach to that has got to be building teamwork, again, to make sure the Shuttle Program which involves many elements, many contractors, many NASA centers, all play together as a team.

I believe we have got to go back and reinstill in our people, in our participants, a teamwork approach. We also need, in my opinion, to conduct more face-to-face kinds of exchanges among the members of the overall shuttle team, and I believe those things will be looked at very, very carefully and I think with some concentrated efforts toward that, I believe we can build up a system that will improve our overall communications.

I think the overall structure of the Shuttle Program is obviously built upon people and, you know, there are humans all the way up

the chain, all the way from the engineers at the subcontractors to the engineers at the contractors, the NASA centers and so forth.

I think we have got to make sure that each of those participants in the program feel a dedication, feel a dedication to safety, feel a dedication to the program that they are making a valuable contribution and I think we need to do that by personal communications as well as trying to look at our structure to make sure we have not defined something that tend to encourage communications breakdown.

Mr. PACKARD. Mr. Chairman, I would like to come back to a question after my staff brings some information back to me if I could, please.

Mr. ROE. I thank the gentleman from California.

The Chair recognizes the gentleman from Ohio, Mr. Traficant.

Mr. TRAFICANT. Thank you, Mr. Chairman.

I have a few questions, Mr. Moore.

One of the testimony that was offered before this committee by astronaut Tom Stafford was in his opinion after reviewing particular data and films, he felt that the *Challenger* crew could have possibly been saved if there had been any type of positive escape system in operation and perhaps even an opportunity with even basic oxygen masks.

Have you, or any of your staff, or any staff at NASA, reviewed the dynamics of those particular pieces of information relevant to that testimony, and what is your particular response in that area?

Mr. MOORE. Let me tell you, sir, that was a recommendation, as you know, in Chairman Roger's report. I believe it was recommendation VII, to look at launch abort and crew escape systems. We have established teams. In fact, it was set up on April 7, 1984. We have initiated a shuttle crew egress and escape review. We have an active team looking at that right now, taking into account all the data that has been studied prior to the first launch of the shuttle as well as some recent conversations and possible approaches to this problem, and the study team is, in fact, looking at that right now.

We are not prepared today to make any conclusions on what is coming out of that, but we are actively planning to study that very, very carefully and then come back and make recommendations to Admiral Truly as to what steps or actions should be taken.

Mr. TRAFICANT. I know also in your brief statement relative to the two items you are addressing here today, one dealing with the decisionmaking process——

Mr. MOORE. Right.

Mr. TRAFICANT [continuing]. And second, strengthening the role of the program manager, in that regard, the need to strengthen the role of the program manager, who, if anybody, at NASA really has an understanding in total as to what is going on on or about the time of these launchings? And who is in control to actually make an informed, intelligent decision, pending certain crisis information that may develop?

Mr. MOORE. Let me see if I can go back and review for you how we get prepared for a particular launch. Prior to 51–L, at least we had a process called the flight readiness review process.

As I stated earlier, there are a number of centers, NASA centers, involved in the Shuttle Program, mainly the Marshall Space Flight Center, the Johnson Space Center, and Kennedy Space Center. There are also a number of contractors that work with each of these centers in terms of the Shuttle Program.

Each center conducts what we call a level three flight readiness review with their contractors to assess the readiness of the hardware that each center is responsible for in supporting a particular launch.

Following those center conducted reviews, they in turn get together with the level two program office, basically the shuttle technical program office at the Johnson Space Center, and report any issues or readiness statements to the level two office at the Johnson Space Center regarding issues that might be at the Kennedy Space Center and their systems, at the Marshall Space Flight Center and their systems, or at Johnson in their systems that we manage, such as the orbiter.

That, in turn, from that review, is then brought up to my level, when I was the associate administrator, so-called level one flight readiness review, and it is a summary of all the issues and resolutions of problems that have been made in preparing for a particular launch.

It says we had this following problem with this piece of hardware. We resolved it by either changing out the hardware or testing it and found it was OK and so forth. So that is the review that is brought up to my level and at my level, the associate administrator level, we typically have a telecon with the centers. In other words, we get the center personnel on the phone with ourselves.

The contractors are on the phones, the major suppliers of the hardware are on the phones. In addition to that, we have representatives from our SR&QA office or the Safety, Reliability and Quality Assurance Office at NASA.

The chief engineering office from NASA is there as well as members of the Aerospace Safety Advisory Panel who are invited to our meetings and there are some other consultants that would come to our flight readiness reviews.

This would typically take anywhere from 4 to 6 hours, depending upon the nature of the mission. You would go through it from a top-down process all the way down to each of the elements of the mission. Actions would be assigned out of that that were still open and these reviews would typically take place about 10 days to 2 weeks prior to a particular flight. At times, the Administrator would attend such meetings to sit in and listen to the progress and following that meeting, we would conclude that we either would proceed on schedule, and it was a consensus conclusion that we would take recommendations from everybody that participated, and say were we ready to launch or did people have issues with the launch.

Then we would proceed to the launch. That was about 2 weeks. Following that review, there was a launch review at Kennedy, typically about 24 to 48 hours prior to the launch, where essentially the same group would get back together again and assess had everything been done that should have been done in the final proc-

essing and preparations, then following that, proceeded on with the count.

So the count for a mission or a go-ahead for the mission conditionally was given at the time we did the all-up review and said let's proceed toward launch provided we satisfactorily close out all the actions.

Mr. TRAFICANT. I have a couple other short questions. I don't want to belabor this.

Mr. MOORE. I am sorry.

Mr. TRAFICANT. Could you give a one word answer to this if possible?

I am not asking for a definition. Are there too many chiefs at NASA in the decisionmaking process? Yes or no?

Mr. MOORE. No.

Mr. TRAFICANT. As a top man at level 1, do you ever conduct audits of the overall management process at the subordinate levels, that being two and three, to be sure they were working as you had expected them to work, and was there the interchange and interflow of information within the agency that was not impacted upon by outside sources in a decisionmaking process?

Mr. MOORE. Sir, I am not sure I understand your term "audit." What I tried to do in ensuring that we were working together as a team was to hold management counsel meetings with the participants in the program so that issues, in fact, could be reviewed before the entire team outside of a flight kind of a program.

We were doing that when we were not in the process of getting ready for a flight. Management counsels was a means, an approach, of trying to get those kinds of issues out.

The other thing I would like to comment on was that we also talked to different people from time to time about issues they had relative to overall management structure and so forth. So there was no formal audit that I implemented, but I believe there were forums presented so issues that people did have could, in fact, be brought up.

There was also the question of dialog between our program managers in the Office of Space Flight and the project managers at the Centers and that is where we hoped a lot of the technical exchanges and so forth would come up.

Mr. TRAFICANT. The only other thing I would like to say is I believe now everybody is taking a real close look at NASA and that may be a little bit unfair, but some particular agencies you have the old "stab the boss in the back" syndrome. Is NASA a pretty good coordinated type of team effort or has there been a development of individual initiative that has gone outside of the scope of the team aspect that has gone outside the original NASA picture?

Mr. MOORE. I can't comment on the other agencies, but I believe the agency has tried to work very good as a team. I think the fact programs, very complicated programs, have been successful within the agency over the years is in part, a large part, due to the fact it has worked as a team. I think that is something that needs to be looked at very carefully to make sure we are continuing to promote that and that all the expertise across the Centers are being applied properly in a directed, team effort to some common objective. I think that is very important that we look at that in the future.

Mr. TRAFICANT. Do you ever have any pressure from the administration or any outside pressure to try and launch beyond or when your own better judgment may not have been the final decision for such?

Mr. MOORE. No, sir. In my experiences—and we have delayed a number of missions as General Abrahamson talked about in his tenure he delayed a number of missions. We have delayed a number of missions as well.

We have combined missions because of problems and I personally have never had any pressure to launch on a given day.

Mr. TRAFICANT. Thank you, Mr. Moore.

I didn't mean to belabor you and I appreciate your testimony——

I yield back to the chairman.

Mr. ROE. Thank the gentleman from Ohio.

I neglected—you will pardon me, Mr. Moore, to swear you in which I should have done. So if you would be kind enough to stand up and repeat after me.

[Witness sworn.]

Mr. ROE. The Chair recognizes the gentleman from New York, Mr. Scheuer.

Mr. SCHEUER. Thank you, Mr. Chairman.

Mr. Moore, I noticed in your prepared testimony you didn't express a view of any kind, a judgment, an insight.

Mr. MOORE. Yes.

Mr. SCHEUER. It was fairly sterile.

Mr. MOORE. Yes, sir. Let me give you, if I might, my rationale for that. Captain Crippen and General Phillips are out studying those kinds of issues as far as the agency is concerned. I personally have not had an opportunity to sit down and talk with them about my thoughts on this thing and my approach was to respond to questions from this committee in those particular areas.

I intend to do that with Captain Crippen, as a matter of fact, this afternoon, to share my views on the decision making. I did not want to preempt any of their particular thoughts.

Mr. SCHEUER. Look, we invited you here to testify to us. We are hearing a lot of other witnesses, too, and witnesses aren't competitive. They are giving us complementary testimony——

Mr. MOORE. Yes, sir.

Mr. SCHEUER [continuing]. In the sense they all enhance each other and the whole is greater than the sum of the parts and we learn from each of them.

Mr. MOORE. Yes, sir. Sir, I am willing to answer your questions to the best of my ability.

Mr. SCHEUER. Take us to the mountain top, briefly, because I have some specific questions to ask you.

So make this a quick trip to the mountain top, and tell us what you have learned as a long time and very experienced administrator of NASA, with a record of demonstrated success behind you that nobody could question, what have we learned from this experience, and whether the lessons we have learned—how do you think we ought to apply them?

Mr. MOORE. I think, sir, there are a number of areas that we need to look at from the very tragic and hard lessons we have learned from the *Challenger* tragedy.

Mr. SCHEUER. Do you basically support the conclusions of the Rogers' Commission?

Mr. MOORE. As I stated in my written testimony, I firmly endorse the recommendations of Chairman Rogers and I think they have done an outstanding and very commendable job in the depth and comprehensiveness with which they have approached the recommendations.

Mr. SCHEUER. Do you have any other insights in addition to their insights?

Mr. MOORE. I would like to share with you some areas that I think we need to look at as part of the overall decision making and management process for the shuttle. I think we need to go back and to make sure we clearly define the roles of NASA headquarters, the roles of the Centers in the overall management of the STS.

I think we need to relook at that kind of interaction and the kind of specific roles, responsibilities, to ensure that authority and responsibility is commensurate in terms of the role definitions for the various levels of management in NASA.

I think we need to look at strengthening NASA headquarters. I would say that in my tenure at NASA headquarters we had a decline in staff in the Office of Space Flight.

Mr. SCHEUER. A declining staff?

Mr. MOORE. It was a decline in the number of staff, and I think we need to look at what is the proper level of staffing requirements to do this particular job.

I also think we need to look to make sure we get as much technical expertise into the Office of Space Flight as we possibly can.

Mr. SCHEUER. Of course, Mr. Moore, we had plenty of expertise that was infused into the decisionmaking process——

Mr. MOORE. I understand that.

Mr. SCHEUER [continuing]. By the Morton Thiokol people.

Mr. MOORE. But I think, sir, you need to make sure that here in Washington there is a good level of technical expertise that, in fact, can work on a plane with the real experts that the contractors, the engineers, the safety people at the contractors and at the NASA Centers and so forth in terms of making sure this——

Mr. SCHEUER. Mr. Moore, the technical expertise was made available by the Morton Thiokol people and by the Rockwell people, both as to the clear and present danger in their perception that was caused by the O-ring and as far as the Rockwell people, the problem of the freezing temperature, the threat that posed. It was there.

It was known by people and we have had testimony from Michael Weeks that he briefed you on that critical briefing in August 1985, showed you the briefing documents and so forth. So our question has to be how could this have happened if you, at the highest level in Washington, were briefed by Mr. Weeks on every aspect of that—I think it is August 19.

Mr. MOORE. It was August 19, I think, sir, was the briefing date.

Mr. SCHEUER. You got a briefing and you got the briefing documents according to Mr. Weeks. I asked him the question right here where we are sitting today.

Mr. MOORE. Let me comment on that, if I might.

Let me comment on the ice situation and then I will come back and comment on the O-ring situation. In the ice situation our technical experts and teams did have a comprehensive set of meetings with Rockwell on the potential impacts of the ice situation.

That was looked at very thoroughly and the people came back in the level 2 office and recommended to me that they felt it was OK and safe to launch. So I accepted their recommendation from the overall expertise relative to the ice.

Mr. SCHEUER. This is after the August 19 meeting?

Mr. MOORE. This was the day, the morning of 51-L launch. It was an ice problem and we knew there would be ice on the launch pad. We left certain things on in the launch system in order to make sure we didn't have a lot of freezing damage.

So we knew there was some ice and we accepted that technical judgment.

Mr. SCHEUER. You were aware at that time of the concerns of the Rockwell safety engineers?

Mr. MOORE. It was reported to me at level 1 that morning that there was not a flight safety concern, that there was a turnaround impact relative to tile that might have some impacts as a result of the ice, but not a flight safety concern on the particular ice.

That was—let me get back to the O-ring.

Mr. SCHEUER. Let's get back to the August 19 briefing.

In this briefing document that you apparently were given by Michael Weeks it says, and I quote, "Efforts need to continue at an accelerated pace to eliminate SRM seal erosion." Somewhere in that briefing it mentions before another launch. That was the thrust of the testimony.

Mr. MOORE. On August 19 I had planned to attend that briefing. The morning of August 19 when that briefing was given I, in fact, was working with our center directors on an engine problem. I did not attend that briefing.

Mr. SCHEUER. This is not an issue, Mr. Moore.

Mr. MOORE. I did not get the report from Mr. Weeks. I did not read that report that was given to NASA headquarters on August 19. So if that was the lead that was not true.

Mr. SCHEUER. Let me read to you Mr. Week's testimony.

Mr. MOORE. Yes, sir.

Mr. SCHEUER. His testimony before this committee in this very room, "I did brief Mr. Moore that evening of August 19 as we were want to do in the early mornings and evenings. I briefed him on the results of that—"—that is the meeting—"—and told him about the briefing and showed him the briefing."

Presumably, that is the briefing documents. "as we left that evening, I said I was still not quite satisfied and I wanted to call somebody that I had great trust in." So on and so forth.

Mr. MOORE. If that was the situation that certainly is not commensurate with my recollection of the situation. Mr. Weeks did say he had attended the briefing, that he did review the situation with Morton Thiokol and the Marshall people and he felt at that time that his judgment was that it was OK to proceed in terms of our course of action.

That is the extent of my knowledge of the August 19 briefing and the first time I saw the briefing was actually after the *Challenger* accident on January 28.

Mr. SCHEUER. Well, now, the Rogers' Commission concluded in their report—and I am quoting—"the O-ring erosion history presented to level one at NASA Headquarters in August 1985 was sufficiently detailed to require corrective action prior to the next flight."

Mr. MOORE. Right.

Mr. SCHEUER. Do you agree with the Rogers' conclusion that headquarters should have corrected the problem prior to the next flight?

Mr. MOORE. In our hindsight and looking at the August 19 briefing and knowing what we know today, I would say yes, we should have corrected all the O-ring problems before the next flight. Yes, sir, I would agree with you.

Mr. SCHEUER. Did Mr. Weeks tell you that Thiokol was calling for an accelerated pace to eliminate SRM seal erosion?

Mr. MOORE. To my recollection, no.

Mr. SCHEUER. There seems to be a very serious conflict.

Mr. MOORE. I understand.

Mr. ROE. The committee will go and vote and return as quickly as possible. Then we will refer back to Mr. Scheuer from New York.

Mr. ROE. I will recognize the distinguished gentleman from California who has an ongoing question with Mr. Moore he would like to propound.

Mr. PACKARD. Thank you, Mr. Chairman.

I spent some time reviewing the implementation plan, which I was very impressed with, frankly, and was very pleased to read carefully. It appears to do a good job on the short term of getting us back into flying again, taking care of the concerns and the recommendations of the Presidential Commission, and I guess if there is any area that stood out, at least to this member, it was that beyond that, I am not satisfied that there is a good plan to keep us from a future accident.

Once we get to flying and we fly with success, as in the past, we become rather—I hate to use the word complacent, but it is easy to become satisfied with the status quo and this plan is to get us going, but I sense that it would be easy for us to fall back to where NASA develops its organizational plan and develops its flow plan of review, but it also—I do not see an ongoing, independent review system in the plan for a 5-year, a 10-year review of where we are at at that point in time.

That gives me concern. I sense that we could fall back into the same communication problems; people are people. We can run into some review or it calls for a review of criticality lists and recertification of those, but 5 years from now we may need to recertify that list again.

I see no ongoing program; that bothers me.

Would you comment, please?

Mr. MOORE. I think in the near term there are a couple of things that I think Admiral Truly and Dr. Fletcher have done to give us independent looks at this thing, not with outside people necessari-

ly—one is Admiral Truly is planning to set up a flight safety panel, and I think that is a good approach to setting up an organization that has flight safety essentially tattooed on their forehead and that is a continuing kind of presence of flight safety.

I think the other thing that the administrator has done, which hopefully will be a long-term, positive thing relative to flight safety and looking at the progress of the program downstream and ensuring that the proper checks and balances are made to set up an independent SR&QA office, safety reliability and quality assurance, and to put that organization at a very high management level reporting directly to the administrator and if that function is implemented properly, it is another way to get the presence for the long term.

You might also look at setting up or periodically calling in an independent group from the outside to sit back and essentially get out of the trees and try to look at the forest.

Mr. PACKARD. That is what I would like to see.

Mr. MOORE. I think that is something that should be considered and I believe it will be considered as to how you provide independent oversight over the very long term after you have gone back and gotten a couple of years of flight under your belt, you want to make sure that the system is as keen as ever. You want to maintain acuteness in the system and make sure everything is sharp and the lines of responsibility are clear.

I think that can be done and I believe that idea will be looked at as part of Captain Crippen's activity and General Philips' activity.

Mr. PACKARD. Organizations tend to be self-contained, impervious to external review and oversight and they set up their management system, rules and procedures and guidelines, but at the same time they tend to set up their own oversight and review process and sometimes they get caught up in the overall—and it would take an outside, independent organization to occasionally look at them and see that they aren't rootbound.

I mentioned the criticality issue. That is recommendation No. 3 wherein it says, NASA and the primary shuttle contractor should review all criticality 1, 1-R, 2-R problems and hazard analysis and then to recertify those.

I would like to see, after another 5-year program, once we are flying again, 5 years from now, a rereview of that. I think that as now we can see that there are some areas that perhaps ought to be moved from one category to another and maybe some recertification.

I would assume that 5 years from now we may have a different view in some areas. I think it would be worthwhile to reevaluate it again at the end of a period of—not necessarily 5 years, but at some point in time have a regular, scheduled rereview.

Mr. MOORE. Yes, sir. I agree with you.

Mr. PACKARD. Thank you, Mr. Chairman.

Mr. ROE. I thank the gentleman.

The Chair recognizes the gentleman from New York.

Mr. SCHEUER. Thank you, Mr. Chairman.

Mr. Moore, we left for that roll call vote just at the point where we were coming to what was apparently a total conflict, a clear—we left for that roll call vote at the point where we had met an

apparent conflict between your testimony and Mr. Weeks', so I want to make certain that everybody understands everybody.

Are you telling us that you didn't receive a briefing from Mr. Weeks and that you didn't receive the briefing documents from Mr. Weeks that was given to headquarters by the Thiokol officials?

Mr. MOORE. To my recollection, the first time I remember seeing that document was on January 29 or January 30, right after the *Challenger* accident. I was shown a document which contained the briefing material. It also subsequently came up in one of the earlier discussions with Chairman Rogers and his Commission which is the other time I have seen some of that.

Postaccident was the first time I had, to my knowledge, as I said, seen that particular briefing. I had not sat down and been given a briefing on the Thiokol presentation on August 19.

Mr. SCHEUER. No kind of a briefing?

Mr. MOORE. No, sir.

Mr. Weeks verbally said that the meeting was held that day on August 19 and that in effect that he felt comfortable with the overall conclusions, although he did have one more concern. He felt he wanted to talk to somebody else at Marshall and he did, I believe, talk to Mr. Hardy and said that he thought based on the data and also on the Titan success that in fact there was an acceptable position as far as he was concerned and that is where I left the information and that was the information I was given.

Mr. SCHEUER. He didn't indicate the kind of depth of concern that would have led you to believe that additional time was needed or that additional resources needed to apply to some of these problems before launch?

Mr. MOORE. No, sir. I did not get the feeling that we should have grounded the shuttle fleet prior to the next flight as a result of that particular briefing. We had also had——

Mr. SCHEUER. Let me interrupt you at that point. If you had had this briefing document, you say you didn't get it and that you didn't get an oral briefing as to the contents of this document——

Mr. MOORE. That is correct.

Mr. SCHEUER. If you had both the briefing document and an oral briefing, which conveyed the seriousness of the problems from the Morton Thiokol engineers, what would you have done?

Mr. MOORE. That is a good question and we are looking at it in hindsight. I believe that looking at the document and looking at some of the issues that were cited about criticality 1, flight safety issues and mission success issues that came out in the series of the document there, I believe we would have initiated a formal team to go off and take a much more concentrated look at it.

That is exactly what was done during one of the flights in July where we lost a couple of temperature sensors on the engine. I initiated or asked Mr. John Yardley to chair a committee to look at what we should do about the temperature sensors on the main engine. The morning of the August 19 briefing was in fact when we were sitting down with the directors talking about what we were going to do with the temperature sensors on the engines.

So I believe my actions would have been to form a team of experts to assess this data and to make recommendations on what our course of action should be at that point in time.

Mr. SCHEUER. Mr. Moore, your testimony—it is perfectly obvious to you and to the rest of us—is at serious variance with your deputy.

Mr. MOORE. Yes, sir.

Mr. SCHEUER. Why is there this conflict?

Mr. MOORE. I had not seen Mr. Weeks' testimony prior to today, so I will have to sit down and talk to Mr. Weeks about it.

Mr. SCHEUER. Well, you can read the Rogers Commission report. On 148 item 5 under findings, the O-ring history presented to level 1 at NASA headquarters in August 1985 was sufficiently detailed to require corrective action prior to the next flight.

Mr. MOORE. I agree with that statement there about the data that was presented and so forth.

Mr. SCHEUER. To level 1?

Mr. MOORE. To level 1.

Mr. SCHEUER. And you were the top banana at that time?

Mr. MOORE. I was level 1.

Mr. SCHEUER. They say the buck stops here.

Mr. MOORE. I understand that. I have people in my organization that also have various data that they have to look at and make judgments on and make recommendations and establish positions as far as what actions the Office of Space Flight takes. You rely on the people in your organization to make judgments and to make comments and recommendations to you and that is what I thought I was doing, sir.

Mr. SCHEUER. We had a very serious failure, in fact, a total breakdown of communications at level 1 and NASA in Washington; is that correct?

Mr. MOORE. I am not sure I want to call it a very serious breakdown of communications. Mr. Weeks, as I said, did tell me the night after the August 19 briefing that he had met with the people and he talked about who all was there and listened to the Thiokol briefing with the Marshall people and in his judgment he said I don't think we have overly concern to stop or accelerate the flights. He had one more concern that he said he wanted to talk to one of his people that he trusted. He did talk to George Hardy, I believe, at the Marshall Space Flight Center and came back and said he thought the situation was acceptable.

Mr. SCHEUER. Did he get back to you after talking to Mr. Hardy and report to you?

Mr. MOORE. I don't believe he talked to me after he talked to Mr. Hardy. I do not think so. This has been a year ago and that specific activity is awfully difficult to recollect, the specific actions that exactly took place.

Mr. SCHEUER. Well, now, did Mr. Weeks fail to communicate to you the substance of that August 19 briefing or was it his job to have exercised proper engineering or safety judgment, let's say, on the basis of the facts as he knew them? Was it a failure of decision-making on his part or communications on his part?

Mr. MOORE. Sir, I think that in a position like Mr. Weeks is in, we have to work as a team. For example, and people have to make assessments on situations and I think Mr. Weeks looked at the data and his assessment was that he thought we had a program adequate to cover the activities in the SRB. He believed that after

he had talked to the people at Thiokol and he also believed that, I think, after talking to the people at Marshall and I believe his position was that in fact was an acceptable posture for him to take.

Part of his responsibility is to make technical judgments.

Mr. SCHEUER. And to communicate with you and enable you to be part of the decisionmaking process on something as important as the existence of life-threatening and mission-threatening conditions.

Mr. MOORE. I would say, sir, in looking up and down the system and what has been determined about the SRB from the many analyses and work that has been done in the past, I don't think the system all the way from day 1 of the program really understood all the implications of how the SRB joints worked and I think that we have learned, all of us have learned, an awful lot about the SRB——

Mr. SCHEUER. I hope we have learned something about decisionmaking and communications, too. I find it absolutely painful to sit here and listen to you and you are a decent and knowledgeable man and I respect you, but I find it absolutely painful to sit here and have you tell us that you didn't know about these communications and that you were not part of the decisionmaking process.

Mr. MOORE. I don't want you to come away with that opinion. I am talking about a specific briefing and I am telling you what was given to me after the briefing. That was a report from my deputy, that he believed the situation was acceptable as far as assessment of the data presented to him, and I trust the people in the organization to make those kinds of judgments.

We have to make those judgments on a day-to-day kind of basis, but I did hear at flight readiness reviews, as everybody as a member of the overall shuttle team heard about issues associated with the O-ring problem. I believe the first time this was experienced on the Shuttle Program was all the way back to flight 2.

Mr. SCHEUER. Mr. Moore, time is running short. I read to you before the statement in the Rogers Commission report that level 1 at NASA headquarters knew enough, had sufficiently detailed information that the launch should be delayed until corrective action was taken.

Mr. MOORE. Yes, sir.

Mr. SCHEUER. Now, did you have that knowledge? Did you share that knowledge from the many briefings you had from the continuous input that you had?

Mr. MOORE. I did not as the head of the level 1 office believe the problem with the SRB O-rings was serious enough to consider stopping the launches. If I did, I would have stopped the launches, sir.

Mr. SCHEUER. Where was the failure?

Mr. MOORE. I think——

Mr. SCHEUER. Was it in your being communicated with by Mr. Weeks? Was it a failure of judgment on Mr. Weeks' part that all systems were go? Where was the failure?

Mr. MOORE. I think in looking at the whole situation, I think there was a failure to communicate the technical seriousness from the contractors involved in this program through——

Mr. SCHEUER. The contractors sent it up. It got to Mr. Weeks that there was that briefing in which level 1 of NASA was in-

volved. The safety engineers sent out their clarion call, they were yelling for help.

Mr. MOORE. If you are talking about that one incident, I can give you one answer as far as that incident is concerned. If you are talking about the general understanding we had about the SRB, I can give you another answer.

On the basis of the specific August 19 briefing that was presented, I believe there should have been a stronger statement made to me that we have a much more serious problem by Mr. Weeks or any of the people who attended that briefing. Mr. Weeks was not the only one at the briefing. There were others at the briefing who had some knowledge about the SRB.

Mr. SCHEUER. Who were they that within their job description should have known that they should communicate with you on the seriousness——

Mr. MOORE. I don't recall the specific list of attendees at that particular meeting, but people that were in the overall propulsion area of the office of space flight—and the office of space flight is level 1—that is the level 1—people who had experience in this thing.

I believe if they felt after that August 19 briefing that we had a problem, that the system should be grounded, that somebody would have come and said, "We have got a problem serious enough to ground the shuttle flight."

That did not occur, and I believe it was based on a collective set of judgments that we did not believe the problem was as serious.

In hindsight, I think we should have taken much stronger action after the August 19 briefing. I wish I had read and looked through the particular briefing. I did not, and if I had the knowledge then that I have today, we would have grounded the fleet. I did not have it at the time.

Mr. SCHEUER. You have opened up a Pandora's box of questions, but I do want to thank you for your candor and your forthcoming attitude. It has been of great benefit to this committee.

Mr. ROE. The gentleman from Florida.

Mr. LEWIS. Mr. Moore, should the program management remain at Johnson?

Mr. MOORE. I think that is certainly a topic that is going to be studied very, very carefully. I think there are a couple of options that can be looked at that would keep the major parts of program management that has been in operation at the Johnson Space Center at the Johnson Space Center.

There are a lot of tools, roots and capabilities. I think, on the other hand, there should be some looks at the Office of Space Flight for finding some way to strengthen the overall program management in the Office of Space Flight.

And one concept might be to have a shuttle program director within the Office of Space Flight and working with the level 2 program office at the Johnson Space Center.

My answer is, I believe the level 2 program office, with some strengthening, and the level 1 program office, with some strengthening—we can make it work and it should remain at the Johnson Space Center.

Mr. LEWIS. Do you believe the program manager should control all the resources?

Mr. MOORE. I believe it has a strong say in the resources. That range from assessing is the balance right across the program, because that is a tough job to do when you are looking at budgets and resources, do you have the right balance across the many elements of a shuttle program as far as resources are concerned.

I think, as a minimum, there should be strong consideration given for the program office, the level 2 office, to have change control funding.

Once you have established a base line content for your program, any changes to that must go through the level 2 office, and I think that, coupled with some technical strengthening in the level 2 office, would make a much more solid shuttle program management team.

Mr. LEWIS. Thank you.

Mr. ROE. The Chair recognizes the distinguished gentleman from Texas.

Mr. ANDREWS. Thank you, Mr. Chairman.

Welcome to Washington. I always like it when my new constituents come here. He is not registered to vote, but I am going to take care of that.

Mr. Moore, as I understand, an independent safety office has been established at the Associate Administrator level.

Mr. MOORE. Yes, sir.

Mr. ANDREWS. Safety Officers at the lower level of NASA can report directly up the chain to his office, and I wondered if you would comment on that.

Are you satisfied with that? Does that look like an appropriate response to you?

Mr. MOORE. Well, I think the specific implementation of the shuttle safety panel—I believe that is what you are referring to—has not been defined yet.

I think the Associate Administrator for Space Flight expects by September 1, 1986, to define the specific functions and roles of that shuttle flight safety panel.

As I commented earlier, I think it is a good idea. I think it has to be structured properly to make it work, but it does have a function of making sure that flight safety is on the top of our minds, is on the top of our priority, and I think it can work very, very well, provided the roles and so forth are defined with some degree of specifics to them.

Mr. ANDREWS. As you know, there has been great discussion and debate on going about the mix of vehicles that we need to have for the stable reliable kind of capability we need in the next decade or so.

I wonder if you would give us your thoughts about what this mix should consist of.

Mr. MOORE. Well, I think—let me back up and give you a little background. About a year and a half ago I began working with Secretary Aldridge in terms of complementary ELV's, NASA, and DOD did agree on a complementary balance of fleet between shuttle flights and ELV flights.

I think we need to retain for this Nation a complementary fleet of vehicles. I think we need to do some studies to make sure that any new vehicles we undertake are, in fact, vehicles that will meet the real requirements that we see coming downstream.

It is awfully tough to project over a decade of time, or even two decades of time, what the real flight requirements are going to be for these kinds of vehicles.

So, I think studies are needed and are being done with NASA and DOD, and I think it is very important that we identify what those requirements are and look at what options this Nation has in moving forward to next generation systems.

What is critical now is to underpin those systems with technological basis so that we do not preclude options for going forward with a specific design of an ELV for a manned system or an unmanned system.

There is technology work that needs to be done, and I believe it is important for the Nation to develop that technology so the Nation can, in fact, make a wise choice in terms of what our next systems will be in terms of launch vehicles.

Mr. ANDREWS. Thank you.

Thank you, Mr. Chairman.

Mr. ROE. Thank you very much for being with us and the patience to wait through our rollcall votes. You have made a good contribution through your testimony.

The committee will recess until 1:30. We will reconvene at 1:30, and our first witness this afternoon is Mr. Robert F. Thompson.

[Whereupon, at 12:40 p.m., the committee recessed to reconvene at 1:30 p.m.]

AFTERNOON SESSION

Mr. ROE. The committee will reconvene, resume our hearing from this morning. We have witnesses for this afternoon's session, three people who have served as program managers at the Johnson Space Center since the program began.

I want to welcome Robert Thompson, vice president, space stations, McDonnell Douglas Astronautics Co.; G.S. Lunney, president, satellite system division, Rockwell International; and Arnold Aldrich, manager, National Space Transportation System, Lyndon B. Johnson Space Center, NASA.

I see we are going to be sparse for the moment, but we will proceed.

We will take the testimony first, the prepared testimony, and then we will double back and see what we want to discuss. Suppose we hear from Mr. Robert Thompson first.

STATEMENTS OF ROBERT F. THOMPSON, VICE PRESIDENT, SPACE STATIONS, McDONNELL DOUGLAS ASTRONAUTICS CO.; G.S. LUNNEY, PT, SATELLITE SYSTEM DIVISION, ROCKWELL INTERNATIONAL; AND ARNOLD ALDRICH, MANAGER, NATIONAL SPACE TRANSPORTATION SYSTEM, LYNDON B. JOHNSON SPACE CENTER, NASA

Mr. THOMPSON. Mr. Chairman, members of the Committee on Science and Technology, I am pleased to appear before you today

and am most willing to offer my comments and assessments of the Commission's report relative to the *Challenger* accident.

By way of introduction and background, I am a former NASA official having served NASA and its predecessor agency NACA for a period of 34 years. My last assignment within NASA was shuttle program manager.

I served in this capacity for 11 years. My tenure covered the preliminary design phase from 1970 until 1972 and then the design, development, test and evaluation phase from 1972 until after the first orbital test flight in 1981. I retired from NASA following the first orbital test flight of the shuttle and subsequently accepted a position with my current company.

I have carefully reviewed the body of the Commission report and have the following observations:

One, with regard to the physical cause of the accident, the evidence pointing to the joint failure appears to be clear and straightforward. The post accident analysis and test of the joint have clearly pointed out some weaknesses in this design.

Apparently, after 24 successful launches a combination of conditions during the 51-L launch finally added up to a disastrous failure. I don't feel that I can add any useful observations to the basic cause of the accident.

Two, in your letter of invitation you asked especially for my comments and assessments pertaining to the decisionmaking process and the role of the program manager.

I would first like to make an observation on the decisionmaking process. Evidence in retrospect points to a long period of time especially based on post flight inspections when the joint design weakness was "sending a message" and the true potential of this message was not perceived and reacted to.

This, combined with prelaunch discussions between Marshall and Thiokol points out the need for a process that must pervade the shuttle management team in the future. A very strong risk management—I have parentheses around risk management. I will be happy to expand on that. It has a certain meaning to me. A very strong risk management organization must be kept in place and a continuing search for potential failures must be maintained. Unfortunately, this is easier said than done and the decision to fly will always contain some risk. We must, however, regain our ability to use the shuttle effectively.

The role of the program manager in this risk management organization must be very strong and clear. The entire program organization from top to bottom must be clearly chartered and as people come and go these organizational relationships must be carefully maintained. Direct and appeal channels must be clearly understood and utilized.

In conclusion, I would like to state that I endorse the nine basic recommendations of the Commission and feel that the report has been very effectively prepared.

I would be most happy to answer any further questions that you might have.

[The prepared statement of Mr. Thompson follows:]

U. S. HOUSE OF REPRESENTATIVES

COMMITTEE ON SCIENCE AND TECHNOLOGY

SUITE 2321 RAYBURN HOUSE OFFICE BUILDING
WASHINGTON, D. C. 20515

Presented By
ROBERT F. THOMPSON
Vice President, General Manager
Space Station

McDonnell Douglas Astronautic Co.
5301 Bolsa Avenue
Huntington Beach, CA 92647

MR. CHAIRMAN, MEMBERS OF THE COMMITTEE ON SCIENCE AND TECHNOLOGY. I AM PLEASED TO APPEAR BEFORE YOU TODAY AND AM MOST WILLING TO OFFER MY COMMENTS AND ASSESSMENTS OF THE COMMISSION'S REPORT RELATIVE TO THE CHALLENGER ACCIDENT.

BY WAY OF INTRODUCTION AND BACKGROUND I AM A FORMER NASA OFFICIAL HAVING SERVED NASA AND ITS PREDECESSOR AGENCY NACA FOR A PERIOD OF 34 YEARS. MY LAST ASSIGNMENT WITHIN NASA WAS SHUTTLE PROGRAM MANAGER. I SERVED IN THIS CAPACITY FOR 11 YEARS. MY TENURE COVERED THE PRELIMINARY DESIGN PHASE FROM 1970 UNTIL 1972 AND THEN DESIGN, DEVELOPMENT, TEST AND EVALUATION PHASE FROM 1972 UNTIL AFTER THE FIRST ORBITAL TEST FLIGHT IN 1981. I RETIRED FROM NASA FOLLOWING THE FIRST ORBITAL TEST FLIGHT OF THE SHUTTLE AND SUBSEQUENTLY ACCEPTED A POSITION WITH MY CURRENT COMPANY.

I HAVE CAREFULLY REVIEWED THE MAIN BODY OF THE COMMISSION REPORT AND HAVE THE FOLLOWING OBSERVATIONS:

1. WITH REGARD TO THE PHYSICAL CAUSE OF THE ACCIDENT, THE EVIDENCE POINTING TO THE JOINT FAILURE APPEARS TO BE CLEAR AND STRAIGHTFORWARD. THE POST ACCIDENT ANALYSIS AND TEST OF THE JOINT HAVE CLEARLY POINTED OUT SOME WEAKNESSES IN THIS DESIGN. APPARENTLY, AFTER 24 SUCCESSFUL LAUNCHES A COMBINATION

OF CONDITIONS DURING THE 51-L LAUNCH FINALLY ADDED UP TO A DISASTROUS FAILURE. I DON'T FEEL THAT I CAN ADD ANY USEFUL OBSERVATIONS TO THE BASIC CAUSE OF THE ACCIDENT.

2. IN YOUR LETTER OF INVITATION YOU ASKED ESPECIALLY FOR MY COMMENTS AND ASSESSMENTS PERTAINING TO THE DECISION MAKING PROCESS AND THE ROLE OF THE PROGRAM MANAGER.

I WOULD FIRST LIKE TO MAKE AN OBSERVATION ON THE DECISION MAKING PROCESS. EVIDENCE IN RETROSPECT POINTS TO A LONG PERIOD OF TIME ESPECIALLY BASED ON POST FLIGHT INSPECTIONS WHEN THE JOINT DESIGN WEAKNESS WAS "SENDING A MESSAGE" AND THE TRUE POTENTIAL OF THIS MESSAGE WAS NOT PERCEIVED AND REACTED TO. THIS, COMBINED WITH PRE-LAUNCH DISCUSSIONS BETWEEN MARSHALL AND THIOKOL POINTS OUT THE NEED FOR A "THEME" THAT MUST PERVADE THE SHUTTLE MANAGEMENT TEAM IN THE FUTURE. A VERY STRONG "RISK MANAGEMENT" ORGANIZATION MUST BE KEPT IN PLACE AND A CONTINUING SEARCH FOR POTENTIAL FAILURES MUST BE MAINTAINED. UNFORTUNATELY, THIS IS EASIER SAID THAN DONE AND THE DECISION "TO FLY" WILL ALWAYS CONTAIN SOME RISK. WE MUST HOWEVER REGAIN OUR ABILITY TO USE THE SHUTTLE EFFECTIVELY.

64-548 O—86——9

Mr. ROE. I thank the gentleman for his testimony. Suppose we hear next from Mr. Lunney.

Mr. LUNNEY. Mr. Chairman, members of the committee, my name is Glynn Lunney. I am pleased to have this opportunity to discuss with you the necessary activities to enhance the return of the Space Transportation System as a vital part of our Nation's space program, and I sincerely appreciate the committee's commitment to that objective.

Although I am now in industry and not with NASA since May 1985, I did have the pleasure to serve as the NSTS Program Manager from May 1981 to May 1985. Before that time, I served in various assignments within the NASA at the Johnson Space Center and Washington Headquarters from the beginning of our country's manned space program. This service began with the Mercury Program and continued through all the other manned space programs. My comments today are based on that background as a NASA employee.

Your review, and that of so many others, is a necessary and valuable part of understanding the 51-L tragic accident and taking the steps to improve the technical and management practices as deemed to be required. It is my belief that this tragedy must serve to rededicate everyone to the task of making our country's space program even stronger than it was before.

Our national experience with the Apollo fire, for example, teaches us that, indeed, a stronger, healthier future can be achieved by properly addressing tragedy, and the lessons it should teach us.

The Rogers Commission Report is very comprehensive and detailed, recommending a number of reviews of design features and STS capabilities. These design areas, such as the SRB, the Critical Item List, landing and escape designs, flight rate and maintenance safeguards are all being assessed by NASA.

You have asked for comments from me on those recommendations especially pertaining to the decisionmaking and role of the program manager. In addition, I will offer you some general thoughts which may be helpful in your guidance of the recovery process.

Recommendation II has to do with the shuttle program management structure. Three aspects of this recommendation have to do with: redefinition of the role of the shuttle program manager; the use of astronauts in management positions; and the establishment of a shuttle safety panel.

NASA has already taken vigorous steps to address these issues. Two committees have already been formed to do so. The first, led by General Sam Phillips, who directed the Apollo Program, will be reporting to Dr. Fletcher later in the year. Astronaut Robert Crippen is leading a second team to add even more attention to these subjects.

As a matter of fact, I had a chance to visit with Bob Crippen's committee last week. I will return to that subject later, and for now note that NASA is already increasing the use of astronauts and their experience in key positions and I expect that to continue.

In the past, through most of the development years of the program and during the years of STS flights, an astronaut was constantly assigned to the shuttle program office and contributed sig-

nificantly. On the third item, NASA plans to establish a shuttle safety panel in the very near future, which is very helpful to the Commission.

Another recommendation is very related to the role of the program manager. Recommendation V deals with the improvement of communications in general and several specific items including: improve communications by MSFC managers; develop a policy for treatment of launch constraints; record flight readiness reviews and mission management team meetings; and assure representation of the flight crew in critical events, such as flight readiness review.

Again, NASA is already well into the activities necessary to address these items. I believe it is also entirely appropriate to emphasize communications at all levels and in all organizations, including Marshall, as the current NASA effort is designed to do.

I expect that more specific procedures for launch constraints and increased discipline and visibility will be forthcoming. There are already substantial records of the key meetings designated by the Commission, thus the preparation and maintenance of increased recording and/or documentation should be easy to do. Of course, it can and should be improved.

In the past, representatives of the flight crew always did participate in the flight readiness review, and there may be ways to strengthen this representation in the future.

In a more general vein, let me return to the objective of making our country's space program even stronger than it was before. Making the decisions and choices to accomplish that goal should lead to an assessment of the first order objectives of the NASA/STS Program.

One approach to this discussion of the first order objectives is to examine the emphasis on certain key aspects of the current system. For example, the premise that the STS should attempt to satisfy all technical and programmatic requirements and other purposes.

As a modification, I believe there is an appropriate role for other launch vehicles. This capability, that is, other launch vehicles, would also help in arriving at a proper flight rate expectation for the STS. Another example is the emphasis on operational. This is, of course, a matter of degree or emphasis.

However, the STS must be viewed as a complex flight system. It will never have the flight experience of an aircraft, with which it is often compared. An undue emphasis on operational, all by itself, can lead to choices driven more by perceived efficiencies, perhaps, than prudent risk management. Properly managed, these modifications in emphasis still allow, and will enhance, a robust future for our entire national space program and manned space activities in particular.

On the subject of program management, I believe that there are some changes and procedures which can strengthen the role of the program manager. Additionally, I believe it is necessary to insist on the system of checks and balances which the centers and the contractor teams provide.

The most likely lesson and resultant emphasis should be on efficiencies and consolidations in the program management process

and constructive use of the check and balance system by all levels. The entire process should be aimed at risk management and communications which are not allowed to bypass the necessary levels in terms of either information or decisionmaking.

In closing, I would like to emphasize that the men and women of the space program and the work they do, are a great source of pride and inspiration to our country and the rest of the world. They will persevere. Your effort to find ways to help and sustain them in this most difficult time are a great service to the country.

I would like to thank you for the opportunity to be here.

[The prepared statement of Mr. Lunney follows:]

STATEMENT OF

GLYNN S. LUNNEY

FORMERLY

MANAGER, NATIONAL SPACE TRANSPORTATION SYSTEM

PROGRAM OFFICE

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
LYNDON B. JOHNSON SPACE CENTER
HOUSTON, TEXAS 77058

THROUGH MAY 1985

PRESENTLY

PRESIDENT

SATELLITE SYSTEMS DIVISION

ROCKWELL INTERNATIONAL CORPORATION
2600 WESTMINSTER BLVD.
SEAL BEACH, CALIFORNIA 90740

BEFORE THE

COMMITTEE ON SCIENCE & TECHNOLOGY

U.S. HOUSE OF REPRESENTATIVES

JULY 24, 1986

Mr. Chairman and Members of the Committee. My name is Glynn S. Lunney. I am pleased to have this opportunity to discuss with you the necessary activities to enhance the return of the STS as a vital part of our nation's space program, and I sincerely appreciate the committee's commitment to that objective. Although I am now in industry and not with NASA since May of 1985, I did have the pleasure to serve as the NSTS Program Manager from May of 1981 to May of 1985. Before that time, I served in various assignments within the NASA at JSC and Washington Headquarters from the beginning of our country's manned space program. This service began with the Mercury Program and continued through all the other manned space programs. My comments today are based on that background as a NASA employee.

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Our national experience with the Apollo fire teaches us that, indeed, a stronger, healthier future can be achieved by properly addressing tragedy.

The Rogers Commission Report is very comprehensive and detailed, recommending a number of reviews of design features and STS capabilities. These design areas, such as the SRB, the Critical Item List, landing and escape designs, flight rate and maintenance safeguards are all being assessed by NASA. You have asked for comments on those recommendations especially pertaining to the decision making and role of the Program Manager. In addition, I will offer you some general thoughts which may be helpful in your guidance of the recovery process.

Recommendation #2 has to do with the Shuttle Program management structure. The three aspects of this recommendation have to do with:

- Redefinition of the role of the Shuttle Program Manager
- The use of astronauts in management positions
- The establishment of a Shuttle Safety Panel.

NASA has already taken vigorous steps to address these issues. Two committees have already been formed to do so. The first, led by General Sam Phillips, who directed the Apollo Program, will report to Dr. Fletcher later in the year. Astronaut Robert Crippen is leading a second team to add even more attention to these subjects. I will return to the Program Management subject later;

and, for now, note that NASA is already increasing the use of astronauts and their experience in key positions and I expect that to continue. In the past, through most of the development years and during the years of STS flights, an astronaut was constantly assigned to the Shuttle Program Office and contributed significantly. On the third item, NASA plans to establish a Shuttle Safety Panel in the very near future.

Another recommendation is very related to the role of the Program Manager. Recommendation #5 deals with the improvement of communications in general and several specific items including:

- Improve communications by MSFC managers
- Develop a policy for treatment of launch constraints
- Record flight readiness reviews and mission management team meetings
- Assure representation of the flight crew in critical events.

Again, NASA is already well into the activities necessary to address these items. I believe it is also entirely appropriate to emphasize communications at <u>all</u> levels and in all organizations, including MSFC, as the current NASA effort is designed to do. I expect that more specific procedures for launch constraints and increased discipline

and visibility will be forthcoming. There are already substantial records of the key meetings designated by the Commission, thus the preparation and maintenance of increased recording and/or documentation should be easy to do. Of course, it can and should be improved. Representatives of the flight crew always did participate in the Flight Readiness Review, and there may be ways to strengthen this representation in the future.

In a more general vein, let me return to the objective of making our country's space program even stronger than it was before. Making the decisions and choices to accomplish that goal should lead to an assessment of the first order objectives of the NASA/STS Program. One approach to this discussion of first order objectives is to examine the emphasis on certain key aspects of the system. For example, the premise that the STS should attempt to satisfy all technical and programmatic requirements and purposes should be addressed. As a modification, I believe there is an appropriate role for other launch vehicles. This would also help in arriving at a proper flight rate expectation for the STS. Another example is the emphasis on "operational". This is, of course, a matter of degree or emphasis. However, the STS must be viewed as a complex flight system. It will never have the flight experience of an aircraft, with which

it is often compared. An undue emphasis on "operational" can lead to choices driven more by perceived efficiencies than prudent risk management. Properly managed, these modifications in emphasis still allow, and will enhance, a robust future for our entire national space program and manned space activities in particular.

On the subject of program management, I believe that there are changes and procedures which can strengthen the role of the program manager. Additionally, I believe it is necessary to insist on the system of checks and balances which the centers and contractor teams provide. The most likely lesson and resultant emphasis should be on efficiencies in the program management process and constructive use of the check and balance system by all levels. The entire process should be aimed at risk management and communications which are not allowed to bypass the necessary levels.

In closing, I would like to emphasize that the men and women of the space program are a great source of pride and inspiration to our country and the rest of the world. They will persevere. Your effort to find ways to help and sustain them in this most difficult time are a great service to the country.

Mr. ROE. Thank the gentleman for his testimony.

The Chair now recognizes Mr. Aldrich.

Mr. ALDRICH. Mr. Chairman, distinguished members of the committee, thank you for the invitation to testify before this committee regarding the National Space Transportation System response to the findings and recommendations contained in the report of the Presidential Commission on the Space Shuttle *Challenger* Accident.

As Dr. Fletcher and Admiral Truly have previously stated, NASA fully agrees with the Commission's recommendations and is vigorously pursuing all actions required to implement and comply with them. I personally found the Commission's report to be an outstanding effort in terms of its clear and thorough treatment of all aspects of this tragedy.

Recommendation II of the Commission report deals with shuttle management structure and recommendation V addresses improved communications. Admiral Truly has assigned responsibility for these two important areas to Capt. Robert Crippen and Captain Crippen has formed a review team with representation from appropriate NASA centers and NSTS Program elements. Their review is well underway leading toward a report to Admiral Truly in the August timeframe. To assure full internal program continuity, my Deputy in the NSTS Office at JSC, Mr. Richard Kohrs, has been assigned full time to this effort.

While it would be premature for me to speculate on the findings and recommendations of Captain Crippen and his review team, I believe they should and will deliberate on a number of specific areas of program activity. Most important will be recommendations to strengthen the interfaces between the various management levels of the program in terms of fully defining the structure, authority, and responsibilities of each level and the lines of communication between them.

In this regard, the involvement of astronauts in space shuttle management will be thoroughly considered. Also, the NSTS budget structure will be assessed to assure an effective balance of budgetary authority for the NSTS Program through both NASA center and program channels.

Third, the process for recording, analyzing, reporting and closing hardware and software anomalies within the NSTS Program must be reviewed for strengthening and reemphasis.

In another area, Captain Crippen's review will be addressing all aspects of the NASA flight readiness review [FRR] process. Again, while I cannot prejudge what will be recommended in this regard, a number of key aspects of the process need to be considered.

These include redefinition of formal organizational representation at FRR, launch minus 1-day (L-1), and mission management team meetings, formal record keeping and/or recording of these meetings, and the role of the space shuttle prime contractors in these reviews.

Also, specific technical content and reporting requirements for these meetings need to be formalized and the subject of face-to-face reviews versus telecons or videcons must be thoroughly considered.

With regard to other recommendations of the Presidential Commission, recommendation IV addresses the NASA Safety Organization and Dr. Fletcher has taken strong action in this regard in ap-

pointing Mr. George A. Rodney as Associate Administrator for Safety, Reliability, and Quality Assurance.

Within the NSTS program itself I am working with the Director of Safety, Reliability, and Quality Assurance at the Johnson Space Center to augment and strengthen SR&QA support of and participation in all NSTS program activities. These efforts will be closely coordinated with Mr. Rodney to assure that they are consistent with overall plans and direction for NASA-wide SR&QA structure.

Recommendation I, solid rocket motor design, III, critical item review and hazard analysis, VI, landing safety, VII, launch abort and crew escape, VIII, flight rate, and IX, maintenance safeguards were all assigned directly to myself as the NSTS Manager by Admiral Truly.

As a result of NASA's close coordination and support of the Rogers Commission, many of the important actions relating to these recommendations were well underway prior to the completion of the Commission's report in response to Admiral Truly's letter March 24, 1986, which directed his strategy for safely returning the space shuttle to flight status. Admiral Truly and I provided a detailed report on these actions to this committee on May 15, 1986, and I would be most pleased to provide any additional information or updating that the committee might desire.

Mr. Chairman, this concludes my prepared testimony. I appreciate this opportunity to appear before you today and would be pleased to answer any questions you may have.

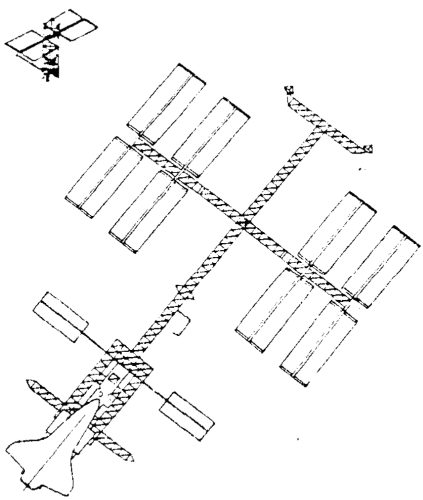
[The prepared statement of Mr. Aldrich follows:]

NASA
National Aeronautics and
Space Administration

Hold for Release Until
Presented by Witness
July 24, 1986

Committee on Science and Technology

United States House of Representatives



Statement by:
Arnold D. Aldrich
Manager, National Space Transportation System
Johnson Space Center
National Aeronautics and Space Administration

99th Congress

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PRESENTED BY WITNESS

July 24, 1986

Statement of

Arnold D. Aldrich
National Space Transportation System

National Aeronautics and Space Administration
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Mr. Chairman and Distinguished Members of the Committee:

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Mr. ROE. I thank the gentleman for his testimony.

Let's go back to Mr. Thompson. You, in your formal presentation on page 2, you spoke to the issue of a very strong risk management. I know you would be disappointed if I didn't come back and ask you because I want to know what you are thinking about on risk management.

Mr. THOMPSON. Let me try to put a little meat on that bone. I think, No. 1, in recognizing the type of system we must continue to live with here, any system that will lift you from the surface of the Earth and take you into orbital velocities has to have a certain amount of inherent risk in it, and a certain amount of inherent risk will always remain in a system of that nature. Just because it has flown well one time doesn't necessarily mean it is going to fly well the second time.

Sometimes these problems are very subtle. Problems don't just stand up and say, "I am a problem, come and fix me." Sometimes they stand up and shout louder than other times. Frankly, this time I think it was standing up and shouting pretty loudly.

The next one might not shout this loudly, so I think we have to look pretty deep in our organization to make sure we are keeping enough technical muscle in the organization to continually search for these pending problems that are sometimes pretty subtle. Sometimes they just don't, as I say, announce themselves. So, you have to be willing to expend the resources and keep that technical muscle in place, and you have to put that technical muscle close to the heart of the issue so that they can perceive a problem if it is beginning to occur.

Just because you hold a flight readiness review doesn't necessarily mean you have got that technical muscle in place. Those things aren't necessarily just connected.

Second, you have to have a set of administrative procedures so that if there is a subtle problem developing, that that anomaly gets properly identified, gets properly collected along with the next piece of data that might occur on the next flight or the next flight, and you have someone looking at that building case that is there; that series of events that adds up to a decision.

Then you have to have an attitude in the organization, and I think the attitude I would characterize somewhat crudely. I have been in this business a long time. You will hear people say if it ain't broke, don't fix it. To me, with a system of this nature, that is a dumb statement.

The right statement, if it is about to break, you had better fix it. The second one is a much tougher one to do than the first one. So I think it is going to be very important for us to keep in place an organization with these kinds of capabilities, and obviously you have to have good communications, have to have good people. You have to have them in an organization where they will talk to each other.

I would just like to challenge us to find the next one and fix it before it occurs. That is an interesting challenge for us today. Where is the next one? That is what I mean by risk management organization, one that can keep the probability, the next one, from occurring, to the point that you can afford to take the safety risk.

And safety should be No. 1. But you still have to make a judgment to go fly.

Safety isn't the only priority in a program like this. You have to do something useful with the system, as well. So, it is that balanced decision that is hard to come to. I think you have to keep an organization in place that understands that risk management and makes it work.

Mr. ROE. Let me ask this question. Some of the people have been making a point of view of the length of time that people stay with NASA. I guess from a point of view that you have such a vast organization now and it is so complex and so forth, that you require some really specialized people; and, of course, as General Abrahamson pointed out this morning, it is a combination of background, training, expertise, experience, particularly.

If you start to look at some of the change of personnel in NASA at present, and you start to look at some of the middle level people starting to look for other jobs and moving out, the uncertainty of exactly what is going to happen and probably the point of laying people off so you can get reorganized, and the whole bit, what do you see?

Do you seem to think there ought to be some kind of mandatory contract where people, when they become involved with NASA, they stay longer? What do you think about that?

Mr. THOMPSON. I guess I haven't thought through enough a mandatory contract. I would have to think about that a little bit.

I do think, however, that most of the people who work for NASA stay for relatively long tenures. I think if you go back and look, NASA people in general stay a reasonably long period of time.

So, I am not so sure the period of time in itself is a necessary problem, although it might be. I would have to look at the data.

I think there are some things that can be done, though. I think in some respects NASA is a relatively new agency in periods of time, and I am not so sure that we pay as much attention or that NASA pays as much attention as they should to making sure individuals, when they are put in certain jobs, fully understand the scope and responsibility of that job. I am not sure the jobs are chartered well enough. I am not sure the reporting channels are laid down perhaps as clearly as they ought to be.

I think when people are selected for the job, there needs to be a careful attention paid to that selection and make sure if the individual is being put in a key program job, that he understands his responsibility along the program channel as well as his responsibilities along the institutional channels. And I think the matter of being sure you have the proper people selected and that those people are properly indoctrinated and trained for their position and they clearly understand the responsibility and reporting channels of their positions, I think those are all areas for improvement.

I think someone mentioned NASA says there are areas of improvement in that area.

Mr. ROE. Mr. Lunney, do you want to give your views of that, and then I will go to Mr. Aldrich.

Mr. LUNNEY. I had not thought much about a contract of any sort. However, I would observe, as Bob did, Mr. Thompson did, that

most people at NASA stay a good long time, as Bob did, I did, and others are doing today.

I would, though, say that there is a thought there that I would relate to, and that is that it is the people who are in it that make NASA what it is. It is not only the people in NASA; it is the set of people they have related to and working within the industry over the years, decades even.

New industrial concerns are becoming involved in the space business, but the string of continuity of experience that people have in the programs is really of value when you move into new programs or new situations. And the communications that you have when men and women have worked together for years and years is a very important commodity that we ought to do all we can to maintain.

I believe then that in a general way we ought to do everything that we can as a country, and in any other way that we can, to support the people who do this kind of work, because it is relatively difficult. They put a lot on the line every day, and they deserve as much support and as much clear direction, as much leadership, as they can possibly get in order to maintain their own sense of comfort—they know where they are; they know what their job is, et cetera.

They will come to work and give you 125 percent every day if we, in the country, will just keep the leadership clearly in front of them, that they need, to know where they are going.

Mr. ROE. Mr. Aldrich.

Mr. ALDRICH. Well, I would have to say that I also had not seriously thought about the subject of mandatory agreement with an employee and the agency. I agree with these gentlemen that many good people tend to stay with NASA a long time. The three of us sitting before you all have worked on it since the early days of the Mercury Program.

As you know, all of the employees of NASA itself are civil servants and are subject to all of the civil service personnel requirements and procedures and structure. And I believe Dr. Fletcher is, in fact, exploring with the Government the possibility of more motivational type of organizational structure, and I think that would be well received throughout NASA if, in fact, it perhaps might create more incentives for quality people and long-term excellent work.

In any regard, the longevity of people we experience within NASA primarily I think is due to the very motivating kind of work we do and the challenge and the interest and the kind of close-knit organization we have had in conducting that work over the years.

Mr. ROE. Well, I will tell you what motivates us, and I just want to get on the record that there is observations that people who have been trained and lived and brought in NASA, over all the years, in different programs, there is interplay back and forth between industries that also support the basic program.

It seems that you are contained under the civil service requirements in the whole, but should there be some kind of premier pay—you have it to a degree—but should there be a more crystallized premium payment schedule for people who are doing some of

these highly specialized jobs to encourage them to stay with the agency?

In other words, industries can hire them away at a much higher price. There is no question about that, from our point of view. But, should there be—as we are thinking over the whole management program and the personnel programming—and you are talking about the incentives, the espirit de corps, and people working together, which is that special thing NASA has.

Should there be some effort to go in toward again a premium pay schedule? I know you have bonuses and so forth, but is there any thought given to that at all, any recommendations to go to that in the management?

Mr. ALDRICH. I believe that is part of the program that is under deliberation. If a program like that can lead to a stronger, high continuity, technical organization for the United States, it would be a positive step. I think that is part of what should be considered, and is being considered, in trying to arrive at that kind of a strong, central, scientific, and technical focus for the Government.

Mr. ROE. Is it under active consideration?

Mr. ALDRICH. Yes, sir.

Mr. ROE. Is that being considered just by NASA? Are there any outside advisors coming in to NASA on some of these management matters?

Mr. ALDRICH. I can't really elaborate on the details of how it has been discussed, although I understand there is a civil service organization at China Lake that had an exploratory program that is with similar objectives to try to strengthen and provide motivation and continuity to the government work force there, and that has been discussed, I know, as either an example or a model for what could be considered for a NASA change.

Mr. ROE. For the record, let me just get these questions on, if you can help us with it.

What has been the involvement of level 2 and level 3 management in the hardware problems, particularly relating to the first group, as the tiles, prior to STS-1's, the brakes, auxiliary power units, UTC seals that failed in orbit, and the general purpose computer? In other words, how much of an active role do levels 2 and 3 play in that area?

Mr. THOMPSON. Let me comment on the items at least before STS-1. If you take a step backward and look at the organization that was set up for shuttle, the levels 1, 2, and 3, the purpose of the level 3 organization is to hold the direct contracts with the industry that builds the hardware. So, that is the level of the organization that has the first handhold on the actual development of the hardware.

The purpose of the level 2, and the reason it was put at a development center, was to use the technical muscle and resources located at that particular facility within the agency to bring an overall systems engineering and integration and program management function in the program.

Now, some hardware-related items are of a systems nature, and have to be worked at level 2. Level 1 in the organization was kept in Washington, because there are just fundamental things in any program of this nature that have to be worked in Washington, the

large interrelationship with the Congress, interrelationship with the executive branch of the Government, the large budget issues, other kinds of external relational issues that are just better done in Washington.

I think the structure of the level 1, 2, and 3 organization of the shuttle was put in place, recognizing the particular unique nature of the vehicle that we were developing, the need to use the resources that the country had developed over the 20 or 25 years prior to undertaking the shuttle development program.

So, if you pick a hardware task like the tiles, the tiles were clearly a problem on the orbiter, which was clearly within a level 3 project office. Now, that doesn't mean that level 2 and level 1 doesn't insert itself in that process, understand what is being done to fix it, making sure all the resources that are necessary to fix it are there.

The primary responsibility remains with the level 3 organization to fix it, and level 2 and level 1 try to help where they can in a management overview, even technical advice or suggestions on other things.

For example, when the tile problem first emerged, there were a number of detailed things that Rockwell had to move out and do under the level 3 project manager's direction. From level 2, we even stepped back and inserted some tests at the flight research center, the NASA flight research center, in order to contribute to the understanding of the tiles. That was a place where level 2 stepped in and helped the activity.

So, I think the organization is structured to respond appropriately. If it is a unique hardware problem right within a project, then the principal task falls on that project to fix that. If it is a hardware problem that level 2 or level 1 needs to insert itself into, it does. If level 2 needs to bring a resource from other places, it does. So, I think each particular problem we have got a little bit of different response, depending on the nature of the problem.

Mr. LUNNEY. I would perhaps offer you some different thoughts along the same line, but to help understand what goes on there.

During the time I was in the level 2 office, I think most of that time Mr. Aldrich, here on my left, was the manager of the orbiter project at level 3. He and I worked together for 25 years, and even with that kind of natural communication that we have, we probably spent 30 minutes to 1 hour or so a day on the average talking about issues of the day that confronted us and what was going on.

Let me give you an example of one way that level 2 could work with level 3 on the subject of tiles, for example. Clearly, putting tiles on the orbiter correctly, being sure they are certified and being sure they fly right, ready to fly right, is a job that is within the purview of the level 3 project and the contractor team, as Bob Thompson just described.

However, one of the things that threatens tiles is the ice damage that might occur during the course of a liftoff, and the ice becomes—because the tank is filled with very cold propellants, and can sometimes, under certain weather conditions, attract ice. The contribution that level 2 can make to the level 3 subject of tiles is to work the problem to assure that, to the maximum extent possi-

ble, there would be no ice on the tank threatening the tiles in the sense of damage during the ascent phase of the mission.

So, in the time I was in office, I found I spent a considerable amount of time, especially early years, working—making sure the problems that the ice that might fall off the tank and any debris that might come back up off the launch pad, which involved the Kennedy research team, was a subject which was well worked and well in front of the team all the time.

I think over the course of the program we gradually saw a clearly decreasing amount of damage—to the tiles—from either ice damage from the tank or from pad damage. So, in that way, our efforts were not redundant but very complimentary in terms of getting the tiles—the level 3 job of getting the tiles, and getting them on right, and the level 2 job, working with the tank project and the Kennedy people in order to assure there would not be any damage.

On other issues, I felt that Mr. Aldrich kept me extremely well informed on all the issues of the day facing the orbiter. We, generally, spent 30 minutes a morning on the phone with the Kennedy team, trying to be sure that we understood what the issues that were facing them—I am speaking now not in a countdown sense, but in a daily sense, office routine sense.

The Marshall people, I probably talked with Bob Lindstrom several times a week, and the length of time, depending on the number of problems—in general, Marshall was dealing with somewhat longer term problems, or let me say it this way: Problems that required a longer time to solve. They might have cracked blades in a turbine engine, and they would set a program in place to find out what that was, do some testing on it, try some fixes, et cetera, and then certify that fix in an engine before we ever got to use it in a flight sense.

So, they were dealing with problems that basically had longer time constants or longer durations or intervals of time while they were in the active solution process.

My main concern for those kind of problems was to stay informed on them, stay informed on when there were likely to be fixes available in the field, because we dealt with questions of what throttle level to drive the engines at to satisfy the mission requirements, how hard you drive the engines. The harder you drive them, the more payload you can throw into orbit.

So, we tried to balance the manifest and the requirements on the system with the maturity of the engine, for example, as it came along through its testing program and settled out where we flew the 100-percent missions for a while; then we flew 104-percent missions for a while. We kept it at 104 percent. And, to my knowledge, we haven't yet flown a 109-percent mission all the way, I don't believe. We tried in that way to sync up or synchronize the activities of the program with the development status of the engine program.

And I can think of some other examples, but aside from a daily matter of staying informed and helping in whatever way we could from level 2, as I described, for example, in the case of the tiles, we found that the communications were relatively strong, although they clearly could be made stronger. And I think the events of the last 6 months will certainly cause that to happen in the program.

Mr. THOMPSON. Let me make one other point. I have heard the question in other sources, should level 2 stay at the field center or should it be returned to headquarters. I think it is very important to recognize that the level 2 function in the shuttle program requires a very strong group of technical people to support it properly and they need to be in a technical environment where they can work, for example, propulsion dynamics problems, flight control problems, things that cut across the system.

Level 2 is not just an office that passes through the money or hands out the mission assignments. It has to be the technical muscle that glues the program elements together in an integrated sense and it has to be left where there are capabilities to run them—the risk management organization of the kind I described.

I don't think Washington is the right place to do that job. I think the right place for that job is where it has been for the last 15 years.

Mr. ALDRICH. As Dr. Lunney indicated, up until August last year, I was the level 3 project manager for the space shuttle orbiter. In that responsibility, it was my job to know all details of orbiter activity and to work directly on a daily and an hourly basis with the level 4 prime contractor for the orbiter, know the requirements and missions and flight conditions that were going to be expected of it and know the problems that were occurring either in flight or anywhere in the vast network of grounds facilities or suppliers of the project on a daily basis.

My responsibility was to understand those problems from criticality of correction or resolution and to keep Dr. Lunney, then head of the level 2 office, apprised particularly of those things that were critical or potentially critical and to recommend to him where fixes could or should be introduced into the program, the nature of those fixes, the schedules and the impacts of them.

I attempted to do that almost as a matter of course because of the fluency of the way the program was structured and the activities flowed from development of flight phases from one mission to the next.

An example that he did not mention was the orbiter brakes. The orbiter breaks had been a very frustrating subsystem in the vehicle probably because of the limited ability to flight test them. There is no way to flight test them without an orbital landing and orbital landings are precious and hard to come by.

But from flight to flight, we would carefully analyze the brakes. We would attempt to define the marginal performance and acceptable use for the next flight and also try to quantify ways that we can instill improvement into the brake program.

Many implementations were brought into the program and thus far we have only had marginal success in improvement. However, during the period we are currently in, we have time to complete a fairly large set of further brake enhancements and we will experiment with those on our next flights landing at Edwards Air Force Base in California, and shortly thereafter a brandnew carbon brake system, which is the ultimate result of frustration of not being able to find complete solutions through our best technical support.

That is an example of how we worked and I believe is typical of how the levels 4, 3, and 2 should report, the level between 2 and 1, which I now deal with completely also, again is and should be a chain of regular communications of activity in the program, particularly with sensitivity to issues or problems that may be being experienced.

Mr. ROE. the gentleman from Florida.

Mr. NELSON. Thank you, Mr. Chairman.

You three are no doubt aware of the safety incentives in the shuttle contracts which, as I understand it, are a $5 million fine in one instance and a $10 million fine in another, and my question is, is it possible to design a set of safety incentives in the contract that would give more incentives for safety other than what is in there already?

Mr. THOMPSON. Let me offer, I guess, two comments to that. One, the type of safety that we are looking for for a system like the shuttle, I think they can be enhanced with these kind of stipulations in a contract. They can't truly be bought that way.

We have not suffered at all in our manned space flight programs in my opinion from a lack of attention or concern on peoples' part. I think most people in my 25 years or so of experience in this business have been very serious and dedicated about the business they are in and I have never detected that a contractor would deliberately infringe on safety for a profit motive.

Certainly if you hang a larger incentive toward safety, you may enhance a strong focus on safety and I would not say that it wouldn't do some good to enlarge those enhancements. However, I think that is only one facet.

You get a lot of attention by the nature of the type of program you are running, the nature of the people that you want on the program and I think you have to do those things in addition to many other things to keep the risk management properly balanced.

Mr. LUNNEY. That is the way I would see it as far as incentives for safety. They are there. I think we need to be sure we keep them before everybody everyday and find ways to make that more and more a living part of our daily life.

Mr. ALDRICH. I agree with those comments. I think that that is an area we should and will look at, but it has been my feeling and expectation in the program in the past and would hope in the future that we are instinctively emphasizing and focusing on safety and that the contract should not be required to be a driver.

I think it should be balanced and perhaps provisions could be added, but not as a primary means of achieving the safety support we need.

Mr. NELSON. Thank you, Mr. Chairman.

Mr. ROE. The gentleman from California.

Mr. PACKARD. Thank you, Mr. Chairman.

I have one series of questions for Mr. Thompson. I understand that in our testimony that you indicated NASA needs to have more technical muscle. Would you explain what you mean by that?

Mr. THOMPSON. I don't know as I necessarily said they need to have more. I said they needed to keep strong technical muscle in a program of this nature. I am not implying they don't have it. I am saying you cannot afford to relax your technical muscle. There will

always be an inherent risk in flying a machine of this type. I think you have to not only keep the muscle at the project level, level 3 in the shuttle program both in the projects offices in NASA and in the contractors, I think you have to keep a strong, dedicated muscle across the system and that technical muscle needs to try to anticipate where the next failure is.

These pending failures are not easy to find. Once something like the 51-L accident occurs, even the janitor knows there was a problem. The problem is to find out where the next one is before it occurs and not let it happen and that is why—you have to put the technical people into an environment where they are receiving the data, the data from flights, people running the program ought to be willing to put special instrumentation in from time to time if there is a trouble area.

You have to collect that data over a period of flights and watch its trends and you have to have an attitude on the part of management that when the whistle is blown, they are willing to do something about it.

You have to create an environment where the people who have a pending problem will come forward and with a loud voice. From what I have heard, I think the Thiokol people came forward, but I don't think they came forward with a very loud voice.

If they had known ahead of time the seriousness, they should have been kicking and screaming. They shouldn't have been putting it as one item on a briefing chart.

So you have to create an attitude in a risk management organization where people will be heard, but you have to deal with the hand wringing. I have never been where people aren't wringing their hands worrying that things might be bad.

What is the balance between just the hand wringers who are worrying and the real problems that you maybe haven't fixed or that you shouldn't fix and that is what I mean by saying it is not easy.

We all know about the accidents that occurred yesterday. It is the ones that are going to occur tomorrow that is the tough thing.

Mr. ROE. Will the gentleman yield?

The interesting part, you may have the impression that because you are the afternoon witnesses and members aren't here, that doesn't mean the substance is lessened. When all those television cameras are playing and the drums are beating and the flags are flying, the place is loaded, when you get into doing the work, that is an entirely different set of circumstances.

The last of life for which the first was made is the important point and that is the substance of your testimony today, so if you are worried and tired, so am I.

Having said that to set the stage, people seem to think they have dimensioned the problems, whatever the problems may be, because we have a commission report.

You spoke just a moment ago that from your point of view that there are certain people who have testified who haven't been very dynamic in their response in the order of magnitude of what happened.

By the same token, if you notice, a great many of our witnesses are coming in an saying, "We believe in the Commission report. It is a fine piece of work, but that is only part of the issue."

That was transcribed into writing. There was a great deal of the Commission observations not put into recommendations that said you ought to be identifying further what we ought to be doing.

I have observed that a good deal of the testimony is if we get this done and we satisfy the Commission's observations, it is all finished and we can run away and we will fly 24 flights a year and so forth.

We speak to the idea of short-range policies. Nobody has put into focus before this committee yet a substantive response to the short-range policy over the next 5 years as it grows across the board with NASA, the military, the intelligence community.

Nobody has come out and said, "This is what we should do in 5 years." What about the long range of it, although out of the testimony there has come fragments of important pieces of fear.

You say we agree and we will start from there. The general brought up an important point when he talked about a methodology of improved quality control in the manufacturing process, throughout the whole system, not just applied to the automatic welding, humans can't do that exactly piece by piece, and he was right, but that should go through the whole system, not just that particular issue. The identification of that particular issue, which leads to the question, we have been talking about that O-ring ad nauseum, but yet we know there is a problem with the brakes.

Now, you say—and rightfully so, we have to identify those issues before they happen and do something about them because if somebody had identified the O-ring or listened to the signs and saw the signs, they would have done something about it sooner. That is what you have all said. That was the reason I brought out not just the management end, those other items, we know of five or six of these criticality items that are really critical.

We know there is a problem with the brakes. Why should that be delayed? Would that not be the primary issue, something we know we should do something about or should we wait until flight 27 or 28 to decide that?

I am not being facetious.

Mr. THOMPSON. Let me comment on the brakes since I am not working directly on the brakes today. I think the brakes have been identified for some time as an ongoing problem. The people flying the vehicle have to decide whether the brakes are enough of a problem to not fly the next flight or whether the ongoing program to bring in an upgraded set of brake capabilities is adequate.

There have been problems with the brakes, but those problems haven't necessarily precluded landing the vehicle safely, and you have to then balance what is an ongoing fix that is acceptable and what is something you have to ground the fleet until you fix.

Mr. ROE. If the gentleman would yield, the interesting point is, though, if you listen to the cross testimony we have received for the last 5 weeks, the dog work that has to be done in finding out what we should be doing is that they knew about the O-ring. That wasn't anything new. It was on flight after flight.

As the general said this morning, one of the great values of the shuttle program per se is that we can retrieve the hardware. You

talked about cracked blades. We know that because we can retrieve the hardware. So they knew about it. That wasn't a big, long query. Nobody considered it to be serious enough.

We will still fly. It is a judgmental factor and we still went ahead and flew. I am not belaboring the issue, but I wonder in criticality 1 list how many, including the brakes, may be involved that are accidents waiting to happen?

Mr. ALDRICH. I would like to respond with a brief summary of some of the things directly in that regard that the program is doing. Not long after the task force started its support of the Commission in Florida, I returned to normal duties in the program and started an activity which we call system design reviews at the STS Program in Washington and we have been in an organized way reviewing all technical issues that each subsystem technical person across the program believes is, are or may be critical for their subsystems.

We had had probably a dozen meetings of that class across the orbiter, the main engines, the solid rockets, the tanks and the ground-support equipment, and we have identified in the process and formally set in motion to correct 68 specific technical items before the next flight.

We have a much longer list of items which are critical, but not constrained to the next flight that we are also going to fix and they are factored into our technical recovery plan that we are working with NASA Headquarters on.

That is not to say that these would not have been found, maybe even were already known, but found through this critical items list review in process, which is a much more complicated penetrating review of every element of the program.

These are to find the sensitive areas in the program that someone knows about and wants addressed at high levels, and we have been conducting those reviews regularly assigned to the actions and are pursuing them weekly for status and achievement of the schedules, and they cover issues like brakes, the goodness of the orbiter windows, the goodness of the thermal protection system, a number of issues with performance of the main engines, other issues related to the solid rocket booster components that aren't part of the motor itself and I believe the sense of what you are asking for is a real strong focus from my perspective and my point of view in the program and we are actively working to try to achieve those objectives you referred to.

Mr. ROE. Could you send us a copy of that interim report?

Mr. ALDRICH. Yes, sir.

[The information to be furnished can be found in appendix 2, p. 325.]

Mr. ROE. The gentleman from California.

Mr. PACKARD. Thank you, Mr. Chairman.

I think that the chairman brings up a point that I have worried about all the way through these hearings and it has been the thrust of many of my questions.

I was at the landing when Senator Garn came down and witnessed the blowing of the tires and the failure of the brakes on that landing. It was my first landing observation. Had that created an accident that would have caused damage to the vehicle and pos-

sible injury to the crew, we would have grounded the fleet and corrected the brake problem.

The question just has to come to mind, would we have then corrected the O-ring problem? I don't know. We probably would have fixed the brakes and got back into flight as quickly as could because it likely would not have been that serious of an accident, but we are right at that point now.

We have grounded the fleet, of course, but we had a failure of the O-ring joint, but there are other nagging weaknesses that we have known about that are also on criticality lists high enough that it could cause a loss of mission and crew.

The question is, Are we going to continue to fly with those weaknesses now that we may repair the O-ring problem? Well, I am not suggesting that we make that decision here today, nor that we on this committee make that decision, but I think it is a policy decision that has to be made, how far do we go with our failure areas, those areas that we have identified that are not operating the way we want them to operate?

How long are we going to go before we actually repair them or ground the fleet?

Another question is a follow up of my first one relative to the technical muscle that we need to maintain and that you, Mr. Thompson, indicated we ought to maintain. We are aware certainly that our contractors that help build and maintain and design and do all of the things that they do, do have a great deal of technical know-how.

They obviously do. Do we need a redundancy of that technical muscle at the contractor level as well as at NASA level? Is it necessary that we have that or would it be more appropriate to bring in the contractors and use their technical muscle without having to have a redundancy of that?

Mr. THOMPSON. Let me try to expand that. I think you have today and you have always had in the manned space flight programs the kind of technical muscle that you have described. Today ongoing in the shuttle program, there is technical muscle at the contractors that build the hardware that are continually working and worrying about the program. There is technical muscle within the development center, Government employees and their support contractors who bring a check and balance to that technical muscle in the contractor field, and there is no way in my opinion you can continue to move forward with something like the shuttle program without keeping that technical muscle in place.

So there are at least two layers of technical muscle today. You have to be sure you have that technical muscle organized right, focused right, worrying the right problems from the right perspective. Again, risk management is not just an event-oriented problem, when something blows up everyone stops and fixes the things they know about at that time and then they fly again until something happens. It is something that has to work every day and when an activity reaches a critical level, then you have to be sure something is done about it before it goes unstable on you.

That is what I mean by risk management. It has to be there every day. If we operate the shuttle for the next 25 years, we will have to keep that activity for the next 25 years.

Mr. PACKARD. I think you have hit upon an important point and one that we have recognized in our hearings, and that is that we were on a program of flying until something happened. I really believe that there are areas where we knew there were problems but we were flying until something happened, and I think that we are at a point now where that is not acceptable. We have got to correct the problems before something happens.

Mr. ALDRICH. I am sure that was an inadvertent path and a subtle path and I think again the burden that the management carries is when a problem has reached a criticality level where you really have to ground things if it is necessary, or can you fix them on the fly, so to speak, and still operate safely? That is a tough problem people like ourselves have to carry every day.

Mr. LUNNEY. There will come a time in the future when the 68 items that Mr. Aldrich referred to and 10 times that many have been fixed and there will be another list on this table and somebody is going to have to decide each time that it is either bad enough and you have to stop or it is acceptable and there is a way to deal with it and you can contain the risk and you can go ahead, because there will be another list 5 years from now.

Mr. PACKARD. I agree with you. I brought with me and I didn't bring it back this afternoon—the implementation recommendations for the recommendations.

I mentioned this morning that was one of my glaring concerns about it, was that it takes care of the problems to get us to flying again, but I still do not see in these implementations actions.

I do not see an ongoing system of protection to keep us from falling back into this point. There will be another 69 items that need to be addressed that we may become complacent.

We are successfully flying with those 69 or so items that are flawed, but not devastating. They don't destroy the mission, and that is what I am concerned about, is we do not have that independent check and balance system built into what these actions call for.

Mr. ROE. Let me build on that, if the gentleman will yield.

Where we are coming from is that the—we don't want to beat this horse to death. I think we have all just about legitimately and effectively exhausted our reviews short of the final policy and long-range policy.

But I think what has come out of it, for example, again, if the General's—a thought occurred while he was testifying this morning. He mentioned that in his new duties as head of the SDI that—he said he was in Utah and discovered this methodology of welding and so forth that he thought from his observation and experience in NASA that this is something NASA ought to be advised about, and it is a good approach, because from a quality control point of view this is a good thing.

If we apply that thought process to what the general said, he said he followed through with NASA and they discovered it was a good idea, that circumstance could be out there if somebody had coordinated methodology to get that information coordinating where it belongs.

For example, there is criticism that says, you have people who work for NASA, then they work for the company, then for the

hardware people. They go from the hardware people and go back to NASA.

I don't think that is terribly incestuous or anything else. I feel that does carry important information back and forth and improvements.

We are all learning from it. But if we have—if out of these hearings a few points emerge that are worth pursuing, that certainly is one of them.

What do we do and what do we have nationally—has NASA thought about setting up a central team someplace that looks for the innovations that are out there across the board? Because it would not only help the NASA Program; it would help the military program.

Is there a coordinating body someplace that is doing that?

Mr. THOMPSON. I think within the development centers of NASA there is a continual activity of the type that you described.

Within NASA and within the contractors that traditionally work for NASA there is a constant effort to stay abreast of welding techniques and what would be a better way to do the job today than it was yesterday.

That is an ongoing fundamental part of the development centers that this Nation has put in place at places like Houston and Marshall, and I think that the technical people, the professional civil servants in NASA, stay pretty abreast of that type of thing and do bring that improved technology into the program on a timely basis.

Again, you have to watch when you bring something new like that in that you don't bring in mischief, too, because there are subtleties that come along with things of that nature, and if you are not careful you invalidate your certification and your development programs.

Mr. ROE. Then we are just letting it bubble up rather than the point of view of being on top of it.

Wouldn't it make practical sense—and following through the gentleman from California's objections, from California—wouldn't it make practical sense from a management point of view to have a team that was specifically assigned on the whole system, above and beyond level 2, level 3, Marshall doesn't talk to Kennedy, Kennedy doesn't talk to Johnson.

It seems to me that the idea of having a group that would be constantly looking—not that they are not doing it in some of the centers—they are—but a dynamic group that is out there anticipatory of these issues rather than let it bubble up from Marshall, from the Johnson Center, et cetera.

Do we sometimes see those things for the forest and the trees? One of the points people make—people say, "Well, you know, somebody has to make a decision."

You can't go along with the reports all the time and be putzing around with this and that. Somebody has to say fly or no fly.

You are saying we have to fly or no fly based on what we know, to the best of our knowledge. Fine. We fly or don't fly. You can't have somebody say, "The wind is blowing too hard; let's stop," or "It is raining there; let's stop."

I agree with that. It is early yet. But we are not satisfied that NASA has come up with a couple of innovative approaches looking down the road beyond another Commission's report.

We don't feel that is bubbling up yet, for whatever that is worth. In other words, should we mandate that in legislation?

Mr. LUNNEY. I don't know about that, sir. If I may, your invitation to me as one person who has showed up here, did discuss the Commission report and indicated that that is what you wanted to talk about.

I sense what you are looking for and you are correct. A lot of the replies have been within that context and I think you are looking for more than that.

I listened to what Mr. Aldrich said was going on on the 69 items, and it occurs to me that maybe you ought to ask people to bring all the rest of the picture to you, because as we continue to discuss this Commission report, you do tend to get a bounded set of discussions the way you have probably received them.

Mr. ROE. For example, while you were talking before, you said, "Well, we have people that are coming up with ideas in the agency."

Mr. Thompson said it depends upon whether there is the atmosphere or the environment is such that you can bring out a point.

I have worked for other organizations. I have been in the military and know when to keep quiet and when to speak out. Has NASA said of our thousands of employees, "We are going to put a drop box here. Anybody got a thought that is bothering them, have you got the guts, help us out and drop it in the box."

Have we done that yet or have we been talking to the same people that led up to the decision process?

We haven't called in the janitor. We have called in the companies, the hardware people, the people that made the decision, the administrators, the executives, and not a single one of the people doing the gut work have been called in, and they are the very same people who are the heart and the dynamics that make it run.

General Abrahamson said we could have all the rules in the world, a whole structure, but if nobody follows it, it is not going anyplace.

So, they haven't called in John Q. Citizen to say, "What are you doing there?" You were taking that part, which is XYZ tape disk one—we dropped it in the sand and you put it there, and where did the tests come out?

Do we have to get to a point—I am hoping if the gentleman would yield, I hope, and this member intends to, in due course—to invite back and then take all the gloves off where we are dimensioning little questions and so forth, that we all have to be careful how we answer them and say, "What should we be doing?"

The Soviets announced this morning—and there is a whole dissertation of where they are going—they are light years ahead at this point. We have people arguing should we have a fourth orbiter. You dare say so, because you are a member of NASA now.

Can you make that comment? Should we? Let me ask the question.

Mr. ANDREWS. I believe we should have a fourth orbiter. I believe it is necessary to meet the objectives that the country has in the next decade.

We can not meet what we intend to do in the manned program with just the shuttle and the projected station program with three orbiters, in my belief.

Mr. LUNNEY. Absolutely, yes.

As a matter of fact, the delay in arriving at a positive answer to that is one of the things that communicates a message of uncertainty to the people.

And it is the people that you want to put this program—John Q. Citizen you were talking about, the men and women who make this thing work—you want to get them back on track and that is a very clear message, one way or another, to them.

Mr. THOMPSON. I think definitely, I can't imagine a society like ours not wanting to be a spacefaring nation, and I can't imagine us being a spacefaring nation for the next few years without a suitable orbiter fleet or a shuttle fleet.

That is the reason we built the shuttle, to have this capability and to let the fleet size go as low as three, I don't think is wise.

I think four is a minimum required if we are going to do the things we want to do here.

Mr. ROE. We have two managers now who are looking at it from a different point of view because they are out in the world and we have one manager here who has inherited the previous manager's responsibilities and he is trying to make the thing run.

Let me ask you something just while we have a few minutes of our own time. What do you see for the future? What should we be telling the American people?

We know that the short 5-year term is. We have to get back in the sky as quickly as possible, as safe as we can. We have to set up our management programs and do it.

Are we capable? Of course, we are. Let's get on with it. We rebuilt the shuttle fleet and convince people to listen and built the fourth orbiter, get spare parts so we are safer.

We get back into a program. Now we are flying a shuttle system. We think about the space station. We have to get that up there because we are spending a lot of money on that. We have to get the inventory off the shelves of our satellites and get going.

We have got to compete with the Japanese, particularly. I see it coming and see what we are going to be doing as far as the French are concerned, and watch what the Soviets are doing in their areas and the glamour of going to Mars and Pluto and where else they are going to go.

What about our policy? That seems to be the shuttle relationship, our telescope, our space station. So what? Where do we go from there? Have you thought about it? You spent 34 years there.

Mr. THOMPSON. You have asked a broad based question. I would like to make a couple of observations.

One of the relatively easy things to do with a question like you ask is to be visionary, to just sort of wave arms and say we should do this or that, but then when you reduce it down to this year's budget or next year's budget, you get a different kind of problem to deal with.

I think that we have to somehow or other keep a general long-term thrust before us while we learn how to deal with programs that have to live and die in budget years.

So, in the one case you are dealing with a yearly problem and in the other case you are dealing with a more visionary problem.

I think the decision made in 1970 post-Apollo to refocus our efforts in the near Earth orbit environment as far as manned space flight is concerned was the right decision at that time and we ought to complete that.

We have only done half of that: Built the space shuttle. The other half is to build the space station and devote our activities around the Earth, understanding how to use this near Earth environment.

The unmanned program certainly ought to reach out and be more outward going in its exploration. I feel strongly that there are going to be some very significant payoffs commercially in the near space environment.

They are probably not going to come as quickly as some would hope, but I think they will come quicker than others might say. I think there are exciting pharmaceutical type items that can be manufactured there better than other places that we will capitalize on.

So, I think the thrust of shifting our manned space flight back to the near Earth orbit, using something like the shuttle, which we have now built, to get back flying and learn to use safely and effectively—I think we need to bring an unmanned fleet on line to help with some of the launches that you shouldn't use the shuttle for, and I think we ought to go forward with the space station.

That is a near-term answer. It is clear that the problems we face as a nation is how to bring it on.

Are you really going to put $400 million in the budget this year and make sure it sticks there and have NASA and industry do the space station, or are we going to talk about it another year?

We have been talking about it 25 years. The near Earth orbit, I think, is well established.

In the longer term, we did nothing more than touch the Moon with our manned programs. I think we will probably, at some time in the future, go back there, analogous to what we are doing in Antarctica and the early explorers that went to Antarctica. You put it to work as an observatory or more permanent research facility.

Manned trips to the planets are probably somewhat further out than maybe the visionaries would hope, but they will come in time.

But I think the real task at hand is get the orbiter operating again, get the shuttle operating again, get a suitable fleet size, get the space station going, get the unmanned vehicle and get that part of the program healthy.

Mr. LUNNEY. Bob has touched on them all. I would underline in the near term getting on with the orbiter replacement and augmenting that with the necessary amount of ELV's so that the balance can be made in the future the way it should, and the country can get on with the space station.

I would caution, we ought to be careful with the space station in the sense that we try to not to make it do all things for all people,

because we have learned that that gets to be kind of complicated, expensive, consumes a lot of money, et cetera, but that it serves the purposes we have for continuing our exploration, continuing in the sense of setting up a base at high altitudes that we can go to the next base from.

After the space station and after we have become very good at navigating and flying in the oceans around our planet, we will probably go back to the Moon with a more long-term stay and on into the future to the planets, but I agree that is out a ways.

So, I would see that as firmly based as possible and that is why I include other launch vehicles.

The country should get itself back into space and get a good, solid, near-term space activity going involving the space station that is sized to do jobs that we can reasonably afford to pay for and get on with it.

I believe, also, something that we haven't mentioned here today may come about—that some requirement may evolve, some national requirement, perhaps from General Abrahamson's work, that would require a larger lift vehicle than we have today in the inventory, and I think we should remain sensitive to that possibility and watch for the future need for that kind of a requirement and be sure we are ready to move in the proper direction at the proper time.

I, personally, don't know what that is yet, and I don't know that anybody else does, but that is likely to be coming on our horizon in the near future.

Mr. ALDRICH. I mostly thought about the shuttle the last few months; however, it occurs to me that the shuttle and the station together—and, again, that is near term, as Mr. Thompson characterized it. The shuttle and the station together really make a single system for achieving our manned objectives in space in terms of activities and customers and the total transportation kind of capability to lead to the steps beyond in the future.

And I viewed it that way for some time, as a complementary and coupled system when the station is also in operation. That was my comment earlier, that I think to have a system like that and to support it you need a fleet of at least four orbiters to do it in a positive and satisfactory way.

And I also agree with Dr. Lunney—for a long time I have viewed a complementary need for unmanned capability to do some of the truck work to support such an elaborate system and yet be a balance for it.

That would be my view of the future. I realize it doesn't take it far downstream, but it gives us plenty to work toward, and I believe it will be a closely coupled interactive set of abilities to provide support for a wide range of objectives.

Mr. ROE. Thank you very much. Your testimony has been a big help to us, and we appreciate your taking your time in helping us with some of your thoughts and ideas.

The committee will stand adjourned.

[Whereupon, at 3:10, the committee adjourned subject to the call of the Chair.]

64-548 O—86——10

JULY 15 HEARING - APPENDIX #1

G. W. Jeffs
President

North American Space Operations
Rockwell International Corporation
2230 East Imperial Highway
El Segundo, California 90245

(213) 647-5274

August 22, 1986

Mr. Robert C. Ketcham
General Counsel
U.S. House of Representative
Committee on Science and Technology
Suite 2321 Rayburn House Office Building
Washington, DC 20515-6301

Dear Mr. Ketcham:

Our response to your letter of August 8, 1986 containing additional questions for Rockwell International, pertaining to the Committee's hearings on the Challenger Accident Investigation, is attached.

The answers are presented, as the questions were organized, for the Space Shuttle Orbiter Program and the SSME program.

We will be happy to provide additional information or clarification as you desire.

Sincerely,

G. W. Jeffs

SPACE SHUTTLE ORBITER PROGRAM

1. QUESTION

When operating problems have occurred with your flight hardware, has NASA encouraged you to fix the problem as quickly as possible or has NASA been stingy with its personnel and resources in responding to the problem, thus delaying a fix due to money or schedule?

ANSWER

When problems occur with flight hardware, NASA supports us and works with us during all phases of the investigation. The first step we take is to ascertain the nature of the failure through analysis and test. We establish whether it is a generic failure affecting all similar components in the fleet or a problem specific to the failed unit itself. Generic problems are immediately addressed and remedied before the next flight, as is any safety-of-flight problem.

NASA has been responsive in providing the resources needed for such activities. Unique hardware failures are corrected on a schedule consistent with the need to restore the unit to a serviceable condition for its next flight. Although limited logistics funding has delayed failure analyses and repair processing of some non-critical hardware, flight schedules were supported.

In summary, NASA has always supported a thorough and timely investigation of all hardware problems. Generic problems have been remedied before the next flight. However, some repair deferments, as well as implementation schedules for design enhancements, have been influenced by funding limitations.

2a. QUESTION

Are you aware of specific launch criteria which, if exceeded or not met, would automatically delay a launch?

ANSWER

Yes. Launch criteria are established in a document approved by the Shuttle program, entitled Launch Commit Criteria (LCC). The Launch Commit Criteria Document (JSC 16007) is a collection of criteria to be met by the flight vehicle and critical ground support equipment prior to launch. Approximately 2,000 parameters must be monitored for redline exceedance during the time periods specified in the document. In addition to flight systems parameter monitoring requirements, the document specifies launch restrictions, weather requirements, and external tank icing criteria. This document is the combined product of parameters established by NASA and its contractors.

The stated purpose of the LCC is to document preplanned decisions, which are designed to minimize the amount of real-time assessments required when off-nominal situations occur. A deviation from the limits established by the criteria is a constraint to launch.

Some launch commit criteria are computer controlled and will automatically halt the countdown, requiring modification of computer programming before countdown can continue. Other LCC parameters are monitored by launch team personnel. In addition to the Shuttle launch commit criteria, each mission may also have unique payload launch criteria that must be met.

2b. QUESTION

How often have you observed or know about instances in which NASA waived such criteria?

ANSWER

Approximately 2,000 preapproved Launch Commit Criteria Document parameters are assessed during each countdown. As the orbiter element contractor, we are aware of instances in which one or more parameters were waived in real time during the launch countdown. The term "waived" as applied to launch commit criteria means the requirement was exceeded to some extent, but was acceptable for launch. Such exceedances are approved by the appropriate NASA and contractor management and engineering personnel after thorough discussions and consultations to ensure that flight safety is not affected. These approvals are made by the same levels of personnel that approved the original criteria. In the process of approving a waiver of a subsystem launch commit criteria exceedance, the subsystem performance is analyzed to ensure proper and satisfactory operation of the subsystem.

For example, during the STS-61C countdown, a temperature sensor in the hydraulic system No. 1 water-boiler steam-vent duct indicated 122°F. The launch commit criterion for this sensor is 130°F minimum. The purpose of the LCC is to establish the function of heaters in the vent duct that prevent steam from condensing and freezing in orbit. It was determined that rainwater, which had collected in the vent duct at the location of the sensor, prevented the temperature from reaching the 130°F redline. Since the function of the heaters was known to be good, the launch commit criterion was waived.

2c. QUESTION

Is the waiving of launch criteria commonplace--the rule rather than the exception?

ANSWER

The waiving of launch commit criteria is the exception, not the rule. Very few waivers occur in relation to the large number of parameters in effect for a launch. It is our general observation that the number of waivers has been declining as the program matures.

3. QUESTION

What is your opinion of NASA's SR&QA performance?

ANSWER

Our association with the NASA JSC SR&QA Division is a close working relationship that began during the Apollo program. From that time through the present Shuttle program, our management and technical staffs have worked as a team to ensure that our hardware design, fabrication, and testing comply with NASA requirements.

Reliability. The orbiter reliability program conducted by Rockwell and the NASA JSC SR&QA Office has been managed within a very strict framework. The effective reliability design tools and disciplined approach that have evolved over the past 25 years have contributed significantly to the success of the space program.

The technology developed for the orbiter failure mode and effects analysis (FMEA) process is probably the most advanced and comprehensive in the industry. It identifies hardware and functional criticalities, emphasizing the elimination or control of critical functions. The residual critical issues have been summarized in a Critical Items List (CIL).

The orbiter failure reporting and corrective action system has been a very effective engineering tool. The failure reports require a detailed failure analysis and a corrective action response. We consider the reliability effort an effective closed-loop system providing valuable support to the program.

Safety. Rockwell's working relationship with NASA JSC SR&QA safety personnel leads to quick notification and consideration of emerging safety issues. We consider the formal safety review processes--such as the Systems Safety Subpanel, the Payload Safety Review Panels, and the Senior Safety Review Board--appropriate and effective in accomplishing their respective goals.

Quality Assurance. The NASA JSC quality assurance organization has been effective throughout the entire sequence of operations in the orbiter program. This involvement encompasses hardware design reviews, subcontractor selection, and manufacturing process control planning. Upon delivery of each vehicle, Rockwell and NASA JSC quality assurance personnel work together to verify that the vehicle and its systems meet design requirements.

4a. QUESTION

Are there any elements of your flight hardware that particularly concern you at this time?

b. What are they?

c. Why do they concern you?

d. What should be done to address these concerns?

ANSWER

All elements of our hardware concern us. As with any flight vehicle, hardware maintenance, checkout, processing operations, inspections, modifications, and overall logistics support operations are critical areas that must be properly administered and controlled. We are constantly on the watch for tell-tale signs that the hardware elements are not performing up to expectations. At this time, all known critical hardware concerns are being actively pursued in accordance with NASA direction.

Rockwell is concerned with the turnaround processing of the orbiter hardware and accountability for its performance. Although Rockwell designed, developed, and certified the orbiter vehicle and its subsystems, the Shuttle processing contractor (SPC) performs the flight turnaround operations, which interrupts the hardware accountability sequence. Rockwell believes that the element contractor should have end-to-end responsibility.

5a. QUESTION

Are there any particular tests that should be run on your flight hardware that have not been run in the past?

b. Why should these tests be conducted?

c. Why have they not been conducted in the past?

d. How long would it take and how much would it cost to conduct these tests?

ANSWER

The technical communities within Rockwell and NASA JSC are continuously defining, refining, and implementing tests for avionics and system hardware. These tests are conducted to provide additional confidence in system hardware, to verify software changes, or generally to increase the existing data bases. With one exception, all identified critical tests have been implemented by NASA.

The exception is our recommendation for flammability testing of crew cabin equipment and materials for 10.2 psia cabin pressure conditions. We recommended these tests in 1980, prior to the decision to adopt the 10.2 psia cabin pressurization used to enhance extravehicular activity. We recommended the 10.2 psia cabin pressure flammability testing because the oxygen concentration was estimated to be 30 to 33 percent versus the 23.8 percent concentration at the previously tested 14.7 psi. At this higher oxygen level, the crew cabin equipment and materials will be more susceptible to ignition and sustained burning.

We considered such testing mandatory to meet the specification requirements imposed upon us. NASA disagreed and provided a waiver to the specification requirement. The NASA position was that the existing body of test data was adequate for extrapolation to the 30 percent oxygen concentration level. Confident that additional tests were not necessary, NASA waived that portion of our specification requirements.

Rockwell is still concerned about the lack of test confirmation of the 10.2-psia cabin pressure flammability limits. We have taken exception on our flight readiness statements to the use of reduced cabin pressure environment and we have again recommended to NASA JSC that such tests should be performed. The cost of such evaluations would be roughly $2 million and 1.5 years of schedule time.

Since the STS-51L accident, numerous design studies and reviews have been initiated that may identify additional test requirements. These new test requirements would be addressed through the formal change review system for approval and implementation.

6. QUESTION

Have your companies ever had disagreements with NASA over design specifications? If so, were they resolved? Do you have any outstanding disputes?

ANSWER

There have been disagreements. Design requirements evolve from initial requirements through conceptual developments, engineering analyses, tests, and other programmatic factors. This process causes changes in specifications that control design, processes, materials, environments, performance, and other parameters. Often there are differences in interpretation and approach between the NASA and contractor engineering communities. However, procedures and systems are in place to resolve these differences mutually and set final program requirements. The program uses Technical Status Reviews (TSR's), Avionics Status Reviews (ASR's), Preliminary Design Reviews (PDR's), Critical Design Reviews (CDR's), Design Certification Reviews (DCR's), and numerous special meetings of NASA and Rockwell management to review issues and concerns about any design drawing or specification.

The product of these reviews is the assignment of actions to reach resolution and final approval of the design. Beyond the initial design phase, design changes and modifications are processed in essentially the same manner. Changes are reviewed at a TSR or ASR and the Change Control Board (CCB) for approval. Any outstanding design dispute is tracked as an open action until it is resolved by Rockwell and NASA management. There are no outstanding disputes between NASA and Rockwell regarding interpretation of design specifications.

7a. QUESTION

Which elements of your flight hardware have exhibited serious anomalous behavior in past flights?

ANSWER

Orbiter flight-critical hardware that exhibited serious anomalous behavior in past flights is listed below:

STS-1	Support strut collapse--forward RCS oxidizer tank
STS-2	Fuel cell shutdown
STS-4	17-inch orbiter external tank disconnect flow liner collapse
STS-9	APU injector failure
STS-51D	Thermal protection burn-through--elevon cove

In addition to above-noted problems, anomalies that required rework or hardware replacement have occurred with the brakes and other elements of the thermal protection system (TPS).

7b. QUESTION

Which of these hardware elements are categorized as Criticality 1?

ANSWER

All of the above hardware elements are Criticality 1.

7c. QUESTION

Prior to the Challenger accident, what was being done to resolve these operating problems?

ANSWER

The five noted serious anomalies were resolved before the next flight. The redesign of the brakes and TPS was under way at the time of the accident.

7d. QUESTION

If not yet fully resolved, what should be done now to address these problem areas?

ANSWER

These problems are either resolved or in work to be resolved.

8a. QUESTION

Based on your observations of the data and discussions with the Rogers Commission, if you had any, to what extent do you agree or disagree with the observation of Commander Stafford?

ANSWER

Rockwell did not have an opportunity to review these data or discuss the information with members of the commission. Therefore, we decline to speculate on Commander Stafford's observations.

8b. QUESTION

In the redesign efforts that are going on relating to the orbiter and evaluations of crew escape technologies, what types of crew escape mechanisms could be implemented in the crew cabin? Are you evaluating such escape mechanisms and are you evaluating the possibility of retaining pressure in the cabin should a disintegration of the Shuttle similar to what happened to the Challenger reoccur in future flights?

ANSWER

Rockwell is currently studying several different approaches for bail-out emergency egress in accordance with NASA direction:

Ejection seats on the flight deck

Tractor rockets on the flight deck

Tractor rockets through the side hatch

Bail-out through the airlock and mid fuselage

We plan to present the results of these studies to NASA JSC in September 1986. We have not been directed to evaluate approaches to retain cabin pressure under vehicle conditions similar to 51L. We are also evaluating existing and potential contingency abort techniques.

9. QUESTION

At the June 25th hearing, John Young noted that although the existing brake system was rated for 55 million foot-pounds, it had failed at 36 million foot-pounds on one of the Shuttle flights. What in the redesign of the system will prevent a recurrence of such a failure at levels significantly below the rated maximum loads?

ANSWER

Neither development nor qualification testing of the main landing gear bakes revealed the problem of high-energy stator damage. Ground testing certified the brake for 55 million foot-pounds of energy absorption. However, stator damage has occurred during landings at levels of 36 and 41 million foot-pounds. Later tests showed that varying the brake energy input rate has a very significant impact on bake performance.

Therefore, NASA has authorized a more extensive test program for both the improved "thick stator" brake and the new structural carbon brake. Instead of using a single energy-rate input and a single test specimen as in the original tests, various landing brake profiles will be used with varying energy-rate inputs. Several brake specimens will be tested under these conditions. Testing under such realistic and varied conditions will provide confidence that the ground tests encompass the real vehicle landing conditions.

10. QUESTION

What does your independent review of the external tank entail?

ANSWER

Rockwell has been directed by NASA Marshall Space Flight Center (MSFC) to perform an independent review of the external tank (ET) Critical Items List (CIL). Included in the products of the review will be a Rockwell-generated failure modes and effects analysis (FMEA) and a CIL for the ET. Rockwell is employing a "bottoms up" approach to the FMEA. ET drawings (Martin-Marietta and vendor) are being audited at the detail part level to identify credible failure modes. An FMEA form will be completed for each failure mode identified. In addition to the description of the failure mode, the FMEA will contain information about possible causes of the failure and the potential effects of the failure upon the Shuttle system for each of the following mission phases: (1) propellant

loading to lift-off, (2) lift-off to ET separation, and (3) ET separation to splashdown. Depending upon the effect of the failure, a criticality category will be assigned to each part, by failure mode, appearing in the FMEA. All parts whose failure effects could possibly result in the loss of vehicle, life, or mission must appear in the CIL.

The CIL contains information regarding failure modes, effects, and causes summarized from the FMEA. It also contains the results of redundancy screens, as appropriate, and the rationale for retaining the part as a critical item. This retention rationale, in effect the heart of the CIL, is subdivided into three categories: design, test, and inspection. Justification for retaining a part as a critical item should be based upon sound design logic that provides adequate safety margin, qualification/certification test program results and acceptance test procedures, and inspection specifications to determine the part's state of health as close as possible to the time of launch commitment. The CIL also describes the failure history and other experience regarding past performance of the part.

Rockwell's independent review of the ET CIL is being conducted by Rockwell personnel working in specialized teams organized along the lines of the specific ET system under review (e.g., electrical, mechanical/propulsion, etc.). The teams are staffed by experienced Rockwell engineering personnel selected for their specialized technical expertise in performing the team's functions. In addition, team membership includes at least one Rockwell reliability engineer. Team technical supervision is provided exclusively by established Rockwell functional and project organizations. Team outputs (FMEA and CIL) will be reviewed by responsible Rockwell management prior to dissemination to NASA to ensure strict adherence to Rockwell's design standards and processes.

Rockwell's responsibilities as an independent contractor reviewer also entail a critique of Martin-Marietta's updated FMEA and CIL documents, which are being prepared concurrently with Rockwell's schedule. Any disagreements in conclusions by Martin and Rockwell will be addressed and resolved by a review board chaired by the MSFC Shuttle Project Manager.

11. Question 11 is not a Rockwell activity; therefore, no answer is supplied.

SSME PROGRAM

1. QUESTION

When operating problems have occurred with your flight hardware, has NASA encouraged you to fix the problem as quickly as possible or has NASA been stingy with its personnel and resources in responding to the problem, thus delaying a fix due to money or schedule?

ANSWER

NASA has provided timely support both in the analysis of ground test and flight data to provide early problem recognition, and in the solution and correction of problems identified. NASA and Rocketdyne use essentially parallel analytical techniques and capabilities in evaluating all test data and hardware following each flight and ground test. This has provided a redundant system minimizing the likelihood of overlooking an anomalous condition indicative of a real, or potential problem.

Once a problem has been identified, an extensive program is undertaken to understand the source and nature of the problem. This traditionally has been performed in accordance with a detailed plan, formulated and concurred in jointly by Rocketdyne and NASA. In numerous cases, NASA resources, in terms of test facilities and technical personnel, have been used to augment the Rocketdyne effort.

First priority is given to determining applicability of a problem to flight engines. Unless it can be shown positively that flight units cannot be affected, the problem is addressed as a flight issue, requiring resolution prior to the next flight.

Long range design improvements to improve the overall operating margin of the engine and, thus, prevent future problems, have been impacted by schedule and budgetary considerations.

In summary, NASA has supported and encouraged the prompt solution of immediate hardware problems. Those representing a potential flight risk or impact have been remedied promptly and effectively. Longer range improvements have been proposed, and pursued within funding limitations.

2. QUESTION

Why don't you test an SSME to destruction? Do you think that you should? Why or why not?

ANSWER

The SSME has been tested several times to failure, finding problems with the design while developing and certifying the engine for flight. The main combustion chamber outlet failure on Engine 2308 is a typical example. It failed at 20,000 seconds (40 equivalent missions) due to high cycle fatigue life problem.

Should we intentionally push the power level up until it fails? We don't think so; the cost ($50M) of destroying an engine or engines would far outweigh the value of failure. There is also a good possibility you may not know what failed because of the damage.

3. QUESTION

Do you feel the fleet leader concept with just a couple of test engines provides an adequate data base to accurately predict the performance capabilities of the SSMEs?

ANSWER

The "Fleet Leader" program requires that two ground test engines, representative of the flight engines in use, maintain at all times, an accumulated total test exposure equal to, or greater than twice the maximum accumulated flight exposure on a flight engine. The policy has recently been amended to require that the test factor of two be achieved at least two years in advance on the ground test engines.

The purpose of the Fleet Leader program is to identify life-limiting problems prior to the occurrence on a flight engine, and sufficiently early to permit correction without impact to the flight program. A sample of two engines was selected to provide contingency in the event one engine were lost or damaged in test, and in consideration of part-to-part variations.

In addition to the Fleet Leader program, other facets of the test program provide assurance of flight engine reliability. The development and certification programs include limits, overstress, and malfunction-type testing designed to demonstrate acceptable performance, and to insure against the presence of infant-mortality failures.

In summary, the Fleet Leader concept, together with the development, certification, and acceptance test programs, represents an extensive data base upon which to base the predicted performance and reliability of the flight engines.

4. QUESTION

What is being done about turbine blade cracking problems?

ANSWER

Fixes to the existing directionally-solidified nickel base superalloy turbine blades, have been identified for the cracking problems and will be incorporated into the SSMEs before the next flight. The high pressure LOX pump fix is already in test and the high pressure fuel pump blade fixes will be into test in approximately two months. Blades with new material, single crystal P&W 1480, are being developed and certified for both pumps to be incorporated into the fleet at a later time.

5. QUESTION

How safe is the SSME to operate at 104 percent of rated thrust? At 109 percent of rated thrust?

ANSWER

The engine is safe and very reliable at 104 percent of rated thrust. The SSME has 269,767 seconds of accumulated testing of which 109,784 seconds are at 104 percent or higher, with 58,184 seconds at 109 percent or higher. The engine has reduced operating margin and requires increased maintenance at 109 percent of rated power level. Improvements (Phase II) to the engine have been developed to increase operating margin at 109 percent operation. Additional improvements are being ground tested to provide more margin and improved maintainability at the higher power levels. These changes will be certified and incorporated into the flight engines before the first 109 percent flight.

6. QUESTION

Are you aware of specific launch criteria which, if exceeded or not met, would automatically delay a launch? How often have you observed or know about instances in which NASA waived such criteria? Is the waiving of launch criteria commonplace -- the rule rather than the exception?

ANSWER

Yes. The Launch Commit Criteria (LCC) document JSC 16007 establishes all launch commit criteria to be met by the flight hardware and critical ground support equipment prior to launch. Approximately 2000 parameters must be monitored for redline exceedance during the time periods specified in the document. The SSME has 45 LCC items per engine.

The stated purpose of the LCC is to document pre-planned decisions, which are designed to minimize the amount of real time assessments required when off nominal situations occur. A deviation from the limits established by the LCC document is a constraint to launch.

In addition to the LCC document, Rocketdyne has developed a flight operations handbook to be used by the launch team to augment the official LCC document.

Launch commit criteria are computer monitored and will automatically halt the countdown, requiring computer commands before the count can proceed. Other LCC parameters are monitored by launch team personnel.

No SSME launch commit criteria has been waived. The waiving of launch commit criteria is the exception, not the rule.

7. QUESTION

What is your opinion of NASA's SR&QA performance?

ANSWER

NASA SR&QA personnel associated with the SSME, including those located at MSFC, Canoga Park, and NSTL, have a very active and visible role in the program. Their activities and involvement cover all aspects of the design, build, test, flights, and overhaul of the main engines.

Aside from the expected differences in technical content between the Safety, Reliability and Quality Assurance disciplines, all three elements have a similar relationship with their Rocketdyne counterparts. First, the NASA personnel act as a check and balance independently reviewing the actions, outputs, recommendations and decisions generated by Rocketdyne in their individual areas of accountability. Examples are

NASA SR&QA participation in SSME flight and test readiness reviews, and NASA audits of the quality and safety systems at Canoga Park, field sites, and major suppliers. Second, the NASA personnel manage a number of SR&QA activities that require direct Rocketdyne support. Examples are the Problem Assessment System and the Safety Issue Board.

Finally, NASA and Rocketdyne SR&QA personnel function effectively as a team to develop needed initiatives. Examples are the establishment of a Software Quality Assurance function and the development of Quality data systems.

Our experience has been that the NASA SR&QA function has performed effectively in the activities described.

8. QUESTION

a. Are there any elements of your flight hardware that particularly concern you at this point?

b. What are they?

c. Why do they concern you?

d. What should be done to address these concerns?

ANSWER

Considering the complexity, level of sophistication of the design, and the high thrust-to-weight ratio of the SSME, there must be constant concern and care exercised. Ground test, certification, and field operations are monitored continuously to detect any anomaly indicative of a failure potential.

The engine has demonstrated excellent reliability in operation at 100 percent and 104 percent of rated power level. Although frequent maintenance on the high pressure turbopumps has been necessary, prescribed limits and inspections have maintained this record. Incorporation of the Phase II turbopumps for the next flight will reduce the maintenance activities and provide greater margin.

It is considered that additional design improvements should be incorporated to the turbine blades and bearings to maintain the same margin and reliability prior to the commencement of flights at 109 percent of rated power. A program to develop and certify these improvements is now in progress.

9. QUESTION

a. Are there any particular tests that should be run on your flight hardware that have not been run in the past?

b. Why should these tests be conducted?

c. Why have they not been conducted in the past?

d. How long would it take and how much would it cost to conduct these tests?

ANSWER

All phases of the SSME test program are currently being reassessed and planned in an effort to raise the level of assurance in the reliability of the flight engines. It is anticipated that the outcome of this will result in additional emphasis on the following:

Thrust Margin Testing - Although previous development and certification programs involved testing to 111 percent to demonstrate margin for 109 percent operation, future programs will include a greater proportion of testing at 4%-5% higher than the intended flight level to demonstrate margin. In addition, it is planned to include operation at a power level in excess of the planned flight level, during the acceptance test of each flight engine.

Demonstration of Redlines - Insofar as it is practicable without introducing unreasonable risk, the engine will be operated with selected parameters at the redline value to demonstrate single mission capability.

Test of Instrumented Hardware - Extensive use was made of instrumented turbopumps during the Phase II development program. This provides a valuable means of evaluating the merits of a change in a minimal number of tests. Two instrumented fuel turbopumps will be tested in the near future to confirm the effectiveness of the design corrections to prior problems. More extensive use of instrumentation can confirm analytical models and quantify the margins and capabilities of the engine. This is increasingly possible in view of the improvement in miniature instrumentation and data processing techniques in recent years.

The testing described above can be accomplished within the next 12 to 18 months, in conjunction with the currently-planned program.

10. QUESTION

Have your companies ever had disagreements with NASA over design specifications? If so, were they resolved? Do you have any outstanding disputes?

ANSWER

Yes, there have been disagreements with NASA over specification requirements. These disagreements were resolved prior to the shuttle flight program by technical interchange meetings, preliminary design reviews (PDRs), critical design reviews (CDRs), and design certification reviews (DCRs).

We are in the process of discussing the worst case heat load for engine nozzle during re-entry on a future heavy weight payload mission. This disagreement has been resolved between MSFC and Rocketdyne, and documentation to correct the ICD has been issued to the system to be approved by NASA Level II. This issue is not critical to the Shuttle operation, but requires additional maintenance to be performed to the engine nozzle if this worst case mission was to be flown without a change to the nozzle thermal protection system.

11. QUESTION

a. Which elements of your flight hardware have exhibited serious anomalous behavior in past flights?

b. Which of these hardware elements are categorized as criticality 1?

c. Prior to the Challenger accident, what was being done to resolve these operating problems?

d. If not yet fully resolved, what should be done now to address these problem areas?

ANSWER

a. None of the SSME hardware has exhibited serious anomalous behavior in past flights. There were some life problems identified in ground test.

b. Turbine blade failures and high pressure LOX pump bearing failures are categorized as criticality 1 but the problems encountered to date were cracking and wear, not actual failures. Crack size and ball wear are controlled by specification and usage by time to assure meeting requirements.

c. A development program designated Phase II was ongoing prior to STS-51L to develop and certify improvements to the high pressure fuel pump 1st and 2nd stage blade, the high pressure LOX pump 1st stage blade, the high pressure LOX pump bearing and the high pressure LOX pump whirl. All but the two-piece damper fix for the high pressure LOX pump blade were successfully certified at 109 percent power level. The LOX blade fix is now in test. Other improvements were also being evaluated to be developed and certified subsequent to the Phase II certification. The flight program has established conservative usage limits that were formally documented and being adhered to while the improvements were being certified for flight.

d. As stated above, these problems were being addressed. We are attempting to accelerate the verification and certification of the improvements so that they can be incorporated for the next flight.

SSME PROGRAM

Additional Questions

1. QUESTION

What is the status of the redesign of the powerhead assembly to a two duct system?

ANSWER

The status of the powerhead assembly with the two duct system is that the design is complete, one assembly has been fabricated and will be built into a development engine. Testing will wait for test stand availability, 1987 or 1988, where support for Shuttle flight resumption will take priority.

2. QUESTION

Is this redesign, known as NASA's "phase two plus program" sufficient, or should a complete new powerhead along with new turbopumps be designed?

ANSWER

The Phase II+ program with the two duct powerhead assembly does increase the operating margins of the SSME; however, Rocketdyne is recommending to NASA additional changes to provide increased margin life. These include a wide throat main combustion chamber to reduce operating environments and thereby increase component life and additional pump improvements with a goal of a 10,000 second pump prior to overhaul. A new powerhead assembly and new turbopumps are not required.

3. QUESTION

Supposedly funding restrictions prohibit going ahead with the alternative pump development program. Have the current pumps met the Shuttle program requirements in terms of maintenance and reliability?

ANSWER

The current pumps do not meet the desired Shuttle program requirements in terms of maintenance. The formal program requirements do allow maintenance, but maintenance every five or six flights is considered too high. The current pump maintenance can be significantly reduced, and

design fixes have been identified that should do this. Short term fixes that can be certified for the next flight will significantly improve maintenance. Longer term fixes incorporated at some intermediate step and/or in an increased margin engine should bring the pump's capability up to a low level of maintenance.

4. QUESTION

Would the main engine be used on any future space vehicle or would a completely new engine be developed?

ANSWER

The NASA and USAF continually study advanced launch vehicles and the propulsion systems for these vehicles. Concepts range from single-stage-to-orbit (SSTO) vehicles placing small (10K-20K) payloads into low earth orbit (LEO) to two-stage heavy lift vehicles (HLLV) capable of orbiting large payloads (300K-400K). Within this range are Shuttle Derived Launch Vehicles (SDLV), Space Transportation System II (STSII), Unmanned Launch Vehicles (ULV) and numerous other configurations including Low-Cost Expendable Vehicles (LCEPS). Some vehicle configurations are completely reusable; others are partially or totally expendable. The Space Transportation Architecture Studies (STAS) and the NASA/MSFC study on Space Transportation Main Engine have identified LOX/Hydrogen engines as a key element in future transportation systems. The SSME, or a derivative of it, can satisfy the requirements for the LOX/H_2 engine in all of these candidate vehicles. It is unnecessary to develop a completely new engine just to obtain these features for future O_2H_2 applications.

5. QUESTION

If the current engine could be used on future vehicles, then what is NASA's plan to redesign the powerhead and pumps?

ANSWER

The NASA maintains an ongoing Advanced Development activity in support of potential future propulsion applications as those described in the response to Question No. 4. While Rocketdyne has defined modifications that could be made to the current SSME to satisfy these needs without the development of a new option, the NASA is pursuing other available options.

Rocketdyne's approach to a derivative engine include: modifications to add a two-position nozzle; capability to operate at 115-120 percent power level (i.e., large throat main combustion chamber); addition of a condition monitoring system, an auxiliary drive on the low pressure pump to start the engine at lower inlet pressure; and possibly a capability for altitude start. These features can be developed for the SSME.

The NASA, through the Alternate Turbopump program, is pursuing alternate high pressure pump options for the SSME which could apply to future application. There are no plans by NASA at this time to pursue an alternate powerhead design other than the two-duct configuration being pursued at Rocketdyne on the SSME Phase II+ program.

6. QUESTION

How much would it cost to develop a new engine vs the cost of significantly upgrading the present engine?

ANSWER

The cost to develop a new high pressure LOX/hydrogen engine would be approximately 1.5 billion, as compared to approximately 200 million for an increased margin upgraded SSME performed concurrently with the presently authorized flight certification extension and Phase II+ program.

7. QUESTION

Has Rockwell determined the cause of the 4000 cycle turbopump vibration?

ANSWER

Yes, we have identified two resonances, one in the thrust cone and one in the injector LOX inlet splitter, that on some engines couple and produce high alternating stresses in the injector inlet. Potential fixes are a collar on the thrust cone, a clamp on the injector inlet, and a modification to the splitter vane. The thrust cone collar is on an engine and ready for test.

8. QUESTION

What was the status of spare parts for the main engines at the time of the STS-51L launch?

ANSWER

All spare parts required in January 1986 were available at KSC, i.e., 1320 parts required and 1320 parts available; however, there were zero spares on the major engine components that included three of the four pumps, the nozzle, one of the five main propellant valves and four different ducts. We are utilizing this downtime to stock up SSME parts. Our plans call for four engines to support each orbiter: three for flight, plus one spare.

9. QUESTION

How many flights could the hydrogen and oxygen turbopumps support before overhaul?

ANSWER

The high pressure fuel pumps were good for five (5) flights and the high pressure oxidizer pumps were good for six (6) flights before they had to be recycled for blade life. Phase II pumps and blade improvements keyed to launch resumption could support ten flights before overhaul.

10. QUESTION

How long does it take to overhaul a turbopump and what does it cost?

ANSWER

A high pressure pump overhaul takes approximately five months and costs approximately 1 million for a complete overhaul. Many of the fuel pump recycles are just for blade replacement which cost $250,000.

JULY 15 HEARING - APPENDIX #2

MARTIN MARIETTA CORPORATION

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Refer to: 86MO-0932

August 19, 1986

Robert C. Ketcham
General Counsel
U. S. House of Representatives
Committee on Science and Technology
Suite 2321 Rayburn House Office Building
Washington, DC 20515-6301

Dear Mr. Ketcham:

With reference to your letter of August 8, 1986, I am enclosing my response to the Committee's nine additional questions for inclusion in the record of the hearing proceedings of July 15, 1986.

The answers to the questions regarding the Solid Rocket Boosters and Space Shuttle Main Engines have been coordinated with Mr. John D. Goodlette, Vice President and Chief Engineer, Martin Marietta Denver Aerospace.

Should you require clarification or additional information for the Committee I am available at your convenience.

Sincerely,

R. M. Davis

Richard M. Davis
President

Enclosure

cc: Eugene M. Poe

U.S. HOUSE OF REPRESENTATIVES
COMMITTEE ON SCIENCE & TECHNOLOGY

TESTIMONY
ANSWERS TO NINE QUESTIONS

SUBMITTED
AUGUST 25, 1986

QUESTION 1

When operating problems have occurred with your flight hardware, has NASA encouraged you to fix the problem as quickly as possible or has NASA been stingy with its personnel and resources in responding to the problem, thus delaying a fix due to money or schedule?

The External Tank operating systems have had only 16 anomaly reports in 25 flights. These anomaly issues have never affected the flight performance of the Shuttle system or safety of the crew. The issues are concerns with the pressure transducer, temperature sensors, liquid level sensors, switch indicators, and thermal protection system debris. For each concern we have received full encouragement and support from the NASA to provide a timely resolution and proper corrective action. The support includes NASA Marshall Space Flight Center Science and Engineering Laboratories technical analysis and test and NASA program management support for engineering design changes and modifications. Their personnel have been very responsive. and proper problem solutions have never been delayed due to money or schedule considerations.

QUESTION 2

Are you aware of specific launch criteria which, if exceeded or not met, would automatically delay a launch? How often have you observed or know about instances in which NASA waived such criteria? Is the waiving of launch criteria commonplace...the rule rather than the exception?

The External Tank has 12 Launch Commit Criteria (LCC) that are mandatory requirements for launch. These include pressures, temperatures, liquid level and hazardous gas detection requirements necessary to ensure flight performance and safety. Seven of these are controlled by the Ground Launch Sequence (GLS) software so that a violation of requirements produces an automatic launch delay. With 25 launches to date there has never been a violation of any of these seven LCCs. The other five LCCs are two temperatures and three hazardous gas measurements which are monitored by console operators. In the history of Shuttle flights there have only been two instances where these criteria have not been met. Both occurrences were the nose cone compartment temperatures on the 51-L launch attempts. The first occurrence was the day of the launch abort and the second occurrence was the day of the actual launch. In each instance there was a completely documented level II approved waiver to these criteria that included the rationale for proceeding with the launch. In no case did a component or system exceed the qualification base. Comparing the number of LCC (12 per launch attempt) and number of flights (25) with the number of waivers (2), it is concluded that the processing of waivers to the LCC is not commonplace and more of an exception than the rule.

QUESTION 3

What is your opinion of NASA's SR&QA performance?

Martin Marietta interfaces with NASA Safety, Reliability and Quality Assurance (SR&QA) at the following locations:

MICHOUD ASSEMBLY FACILITY - There are three NASA R&QA people assigned to this facility. Hardware acceptance has been delegated to Defense Contract Administration Services (DCAS) represented by 62 people. The NASA personnel administer the DCAS delegation and perform some surveillance of Martin Marietta performance to the SR&QA requirements. In our opinion the NASA's performance at this facility is very good. They do support the program and work issues with other Shuttle element interfaces to the extent they can. We do recommend consideration be given to an improved system for SR&QA interfacing between Shuttle elements. Their administration of the DCAS delegation is very satisfactory, they actively interface and resolve issues when neccessary and as requested by Martin Marietta. DCAS's performance as the hardware acceptance agency of NASA is also very good. Overall our interface with the DCAS and the NASA is excellent.

NATIONAL SPACE AND TECHNOLOGY LABORATORIES - Although we have had little activity at NSTL for the last two years, prior performance by the NASA was good, in our opinion.

KENNEDY SPACE CENTER/VANDENBERG AIR FORCE BASE - Our interface with the NASA SR&QA has been very limited since the SPC contract was implemented, but prior to that time, our opinion of their performance was also good.

MARSHALL SPACE FLIGHT CENTER - The External Tank and the Shuttle flight readiness reviews are supported by a full time assigned R&QA person who actively works ET quality issues. Also, there is a specific safety assignee to the ET Project Office. Reviews and issues are supported by the central Safety and Quality offices at MSFC. In our opinion, the Quality Assurance activity is very good.

The Center Board Flight Readiness Review is supported by the Director of Reliability and Quality Assurance and by the Director of Safety. Both are on the Center Board. Consideration should be given to having the Reliability and Quality Assurance Director report to the Center Director. The Director of Safety already reports to the Center Director. While we are not aware of any significant past problems with the current organizational relationship, this would provide a totally independent assessment in the crucial period ahead.

QUESTION 4

a. Are there any elements of your flight hardware that particularly concern you at this point?
b. What are they?
c. Why do they concern you?
d. What should be done to address these concerns?

Several issues concern us and remain as on-going activity for design improvement.

The first issue is the ullage pressure transducer bias output indications that have occurred on some flights. Although these transducers have performed satisfactorily in all flights, and have maintained the tank pressures well within the control band, we are continuing to investigate this issue and have an alternative design in development.

The second issue is a potential hazard associated with the hydrogen vent valve, which when indicated closed, could have a small leak. There has been no qualification test or flight history of valve leakage problems. We are conducting extensive analyses and testing as well as evaluating design modifications in the resolution of this issue.

The third issue is the evidence from post separation photos of Thermal Protection System (TPS) divot loss which could cause orbiter tile damage. We have improved the Intertank TPS application process and implemented a design modification to all completed External Tanks. Debris, in general, from TPS or ice must remain as a Shuttle system concern under evaluation.

Another issue is the Range Safety System (RSS) which is installed on the ET. This is not because of any known defect in the RSS design or hardware. We believe it has been well designed and that we have adequately protected the linear shaped charges. Level II is reevaluating the requirements for the system to remain on the External Tank. Removal of the system would eliminate any possibility of inadvertent detonation.

All of the above issues are also being addressed in the current Failure Mode and Effects Analysis (FMEA), Critical Items List (CIL) and Hazard Analysis activity.

QUESTION 5

a. Are there any particular tests that should be run on your flight hardware that have not been run in the past?
b. Why should these tests be conducted?
c. Why have they not been conducted in the past?
d. How long would it take and how much would it cost to conduct these tests?

In our review activity to date, we have not identified any additional test activity required for component qualification or system certification. However, we are planning appropriate development testing associated with the resolution of the issues and design improvements identified earlier.

We are continuing our pre 51-L test of the ullage pressure transducer to understand the cause and correction of the bias mechanism in order to ensure design reliability. Alternate transducer design and development testing is in progress which will lead to complete qualification.

For the hydrogen vent valve leakage issue we are testing H2 flow mixture and combustion relationships to quantify the recent leakage concerns identified. We will also evaluate by test, any design improvements.

TPS testing consists of improving constituent material fingerprinting and process re-validation. This effort was in process prior to 51-L. Our re-review and re-certification of the above hardware currently underway as well as future results from the ongoing FEMA/CIL activities may result in additional testing.

The schedule and costs estimate associated with these activities is currently in the process of completion. This information will be provided, under separate cover, in response to Congressman Robert S. Walker's request during the hearings of July 15, 1986.

QUESTION 6

Have your companies ever had disagreements with NASA over design specifications? If so, were they resolved? Do you have any outstanding disputes?

Although Martin Marietta has had some disagreements with NASA over design specifications in the past, they were all technically resolved without compromise to the quality of the hardware or safety of flight. We do not have any outstanding disputes. However, as discussed in question 4, we continue to have a concern with the Range Safety System (RSS) on the External Tank. We strongly support deletion of the system.

QUESTION 7

a. Which elements of your flight hardware have exhibited serious anomalous behavior in past flights?
b. Which of these hardware elements are categorized as criticality 1?
c. Prior to the Challenger accident, what was being done to resolve these operating problems?
d. If not yet fully resolved, what should be done now to address these problem areas?

We have not experienced any serious anomalous behavior with any element of the External Tank. However, as identified earlier in question 4, we are involved in design improvement activities. Two areas of particular interest are the LH2 Ullage Pressure Transducer and the Thermal Protection System.

The transducer has experienced some minor bias output indications. The instrument is a criticality 1 component but this failure mode is not a criticality 1 issue. Prior to the 51-L accident we had a development program underway to provide a totally new transducer design. This instrument is currently in qualification and several reviews are planned to evaluate it's usage on the External Tank.

The TPS exhibited divot loss on some flights as shown by the post separation photos. This system was not originally included in the FMEA/CIL and therefore, not assigned a criticality category. It was however, assumed to be a critical sub-system, as was the structure, and appropriate measures were taken in the design development and qualification to ensure safety and reliability. We have implemented a redesign of the ET Intertank TPS and are re-evaluating TPS and ice debris concerns.

64-548 O—86——11

QUESTION 8

Independent contractors are assisting NASA in its review of the Critical Items List. Rockwell has the responsibility for the external tank and the Martin Marietta Company has responsibility for the solid rocket booster and the Space Shuttle main engines.

- Could you explain for the Committee what this activity entails from your perspective?

New proposed FMEA/CIL documents are being prepared for the External Tank by Rockwell International under contract to NASA and independently by Martin Marietta Michoud Aerospace. Groundrules covering components have been expanded to include items such as the Thermal Protection System (TPS), Interfaces (between STS elements), venting requirements and other system issues. The results of both teams will be reviewed by the NASA review committee and a final FMEA/CIL document will be issued.

In addition, the existing Hazards Analysis will be evaluated for addition of any new concerns as well as proper closure of previous hazards.

The method of review is as follows:

- Perform comprehensive review of ET engineering drawings and associated source documentation, ET design data drawings, schematics, block diagrams, specifications, test reports, failure reports, checkout requirements and procedures, hazard analyses, etc., including Level II and Level III documentation.

- Review each candidate item to document those failure modes which are credible and consistent with the groundrules and should be included in the ET FMEA.

- Perform detailed comparison between the items/failure modes derived from this assessment and those which are currently in the ET FMEA to identify any items or failure modes which were omitted from the existing FMEA. Subject these items to a thorough analysis by the appropriate technical disciplines to document their associated failure effects, criticality, etc., in accordance with the defined FMEA/CIL review process.

- Produce a new baseline ET FMEA and CIL which are revised/reformatted as required to reflect the requirements stipulated in the "Space Shuttle Failure Modes and Effect Analysis" (FMEA) and Critical Items List (CIL) Ground Rules, EG 5320.1, provided by MSFC.

The reviews provide:

- Independent analysis and technical expertise
- Additional assurance that critical items and their level of criticality have been properly identified and documented
- Additional assurance that the rationale for retention is complete and accurate.

Martin Marietta Denver Aerospace has been assigned the responsibility by the NASA to perform independent reviews of the solid rocket booster and the main engines in a similar manner. These analyses will be compared to those of USBI - Booster Production Company, Morton Thiokol and Rockwell International Rocketdyne.

QUESTION 9

What is your experience in solid rocket boosters that would give you the ability to make sound judgments on Failure Modes and Effects Analyses of solid rocket boosters to determine what elements should be included on the Critical Items List?

- It is our understanding in discussions with NASA that you are engaging outside expertise to support this independent review activity. Could you describe this for us and who would serve on this independent review committee?

For many years Martin Marietta Aerospace has produced systems using solid rockets. At Denver Aerospace, the Titan III, Titan IV, Peacekeeper and small ICBM use large solid rocket motors. Since its inception, Martin Marietta Orlando Aerospace has produced tactical missiles using solid rockets. Our engineering staffs at both divisions include mechanical and chemical engineers with background and experience in solid rocket motors, and our FMEA/CIL analyses have called upon this expertise from both Denver and Orlando.

The Shuttle solid rocket boosters involve more subsystems than the solid rocket motors. The solid rocket booster includes the electro-hydraulic thrust vector control system, an integrated electronics assembly, a range safety and command destruct system, a recovery system, and the structural and thermal protection systems. Martin Marietta products routinely involve the technologies represented in these subsystems.

We have engaged three outside agencies for specific expertise and support of independent review activity of the Space Shuttle Main Engines (SSME). Aerojet Technical Systems was assigned to perform failure mode and effects analyses on the SSME turbopumps. Pratt & Whitney has been engaged to provide critiques of our work on a task order basis. In addition, a small task order has been assigned to Battelle Memorial Institute, this choice having been made because of previous work done under NASA contract regarding failure modes for the Shuttle main engine.

The arrangements described above involve the employment of individuals with specific technical expertise. It is not our intent that they serve as an independent review committee, but rather to participate as team members. Their work will be incorporated into our final results. The individuals have been engaged by means of a subcontract between Martin Marietta Denver Aerospace and their respective corporations.

JULY 24 HEARING—APPENDIX 1

NASA

National Aeronautics and
Space Administration

Washington, D.C.
20546

13 NOV 1986

Reply to Attn of: C:JFM:plg

RECEIVED
NOV 13 1986
COMMITTEE ON SCIENCE
AND TECHNOLOGY

Mr. Robert C. Ketcham
General Counsel
Committee on Science and Technology
House of Representatives
Washington, DC 20515

Dear Mr. Ketcham:

Following the meeting recently held in your office with Mr. Weeks and Mr. Moore to resolve the conflict in testimony taken during the Committee hearings on the Challenger accident, your staff prepared an Affidavit and requested it be reviewed by Mr. Weeks.

Enclosed is an Affidavit, signed and sworn, by Mr. Weeks stating his best recollection of the meeting in question. If there are any questions, please call me.

Sincerely,

John F. Murphy
Assistant Administrator
for Legislative Affairs

Enclosure

District of Columbia
City of Washington

AFFIDAVIT

L. Michael Weeks, being first duly sworn, deposes and says:

I am currently employed by the National Aeronautics and Space Administration (NASA) as Deputy Associate Administrator (Technical) in the Office of Space Flight and have served in that capacity since February 1982. For the 18 months prior to the 51-L accident, I served in two capacities. I was both the principal deputy (the position was not filled) and the technical deputy.

On August 19, 1985, I chaired a meeting at NASA Headquarters concerning the erosion of the solid rocket motor (SRM) pressure seals. This briefing was to have been chaired by Mr. Jesse Moore, who at that time was the Associate Administrator for Space Flight. Mr. Moore was unable to attend this briefing. The briefing on the pressure seals was intended to be a high-level, in-depth discussion on the whole O-ring experience. The participants in the meeting were as follows:

Morton Thiokol - Mr. Mason, Mr. Wiggins, Mr. Kilminster, Mr. McDonald, Mr. Speaks, and Mr. Ross

Marshall Space Flight Center - Mr. Mulloy and Mr. Swinghamer

NASA Headquarters - Mr. Weeks, Mr. Winterhalter, Mr. Hamby, Mr. Wetzel, Mr. Herr, Mr. Quong, and Mr. Bardos

The briefing lasted two and one-half to three hours. The content of the briefing is generally represented by the document entitled Erosion of SRM Pressure Seals, Presentation to NASA Headquarters, 19 August 1985 (Morton Thiokol Publication No. 86110). Although this document contains an extensive history of the erosion problem and steps being taken to resolve it, it did not include data relating to the effect that temperature has on resiliency--the meeting included no discussion of the effect of temperature on the resiliency of the O-rings, nor did it discuss or reference the data that resulted from the bench testing which concluded that resiliency is a function of temperature (after the 51-L accident, I found out this information was contained in a letter from Brian Russell, Manager, MTI SRM Ignition System to James W. Thomas, Marshall Space Flight Center on August 9, 1985). I do not know why this information was not included in the briefing.

At the conclusion of the meeting it was agreed by all participants to adopt the recommendation that it was "safe to continue flying existing design as long as all joints are leak checked with a 200 psig stabilization pressure, are free of

contamination in the seal areas, and meet O-ring squeeze requirements." However, "efforts need to continue at an accelerated pace to eliminate SRM seal erosion." None of the 15 people at the meeting suggested that the O-ring erosion problems were such that NASA should ground the fleet until the problem was solved.

I can attest to the fact that my concern about the O-ring problem was well known. It should be noted that there was extended discussion of the secondary O-ring erosion anomaly during the July 2, 1985, Flight Readiness Review (FRR) chaired by Mr. Moore. The anomaly was dispositioned, and there was a consensus at that FRR that it was safe to fly the July 29, 1985, mission. Notwithstanding the decision made at this FRR, Mr. Hamby and Mr. Davids were sent to the Marshall Space Flight Center to study the erosion problem. Their efforts were recorded in Mr. Davids' memo of July 17, 1985, to Mr. Moore with a carbon copy to me. I personally reviewed the problem in Utah on July 17 and 18, 1985, and, as a result, set up the August 19, 1985, presentation.

At approximately 7:00 P.M. that evening (August 19th), I briefed Mr. Moore in his office concerning the O-ring erosion meeting. The briefing with Mr. Moore lasted approximately 10 minutes. I advised him of the participants, presented him with a summary of the matters discussed, and with their conclusion that it was safe to fly as long as the three caveats referred to above were met. We discussed the history of the erosion problem on both case-to-nozzle and case-to-case joints. While I did not explicitly use the term "accelerated pace," the recommendation of the briefing to proceed at an "accelerated pace" was addressed by me by the discussion of our ordering 72 larger forgings and the case-to-case and case-to-nozzle joint changes to be incorporated into the last static test firing of the Filament Wound Case (FWC) for November 1985. I also discussed construction of the erosion/deflection test rig which was proceeding vigorously. As we left that evening, I said I was still not quite satisfied and I wanted to call Mr. George Hardy of the Marshall Space Flight Center, an engineer in whom I had great trust. I called Mr. Hardy the next day (August 20). I reported back to Mr. Moore that Mr. Hardy believed it was safe to continue flying.

I believe I carried the briefing document with me into my meeting with Mr. Moore. I did not leave the document with him. Mr. Moore did not request a copy of the document. Insofar as my statement before the Committee on Science and Technology on June 12, 1986, was construed to mean that I showed Mr. Moore the briefing document page by page, such was not the case. The two key recommendations on the last page of the briefing were (a) that it was safe to continue flying and (b) that efforts should proceed at an "accelerated pace." Both of these items have been discussed previously in this affidavit.

I have reviewed the statements made by Mr. Moore to the Committee on Science and Technology on July 24, 1986, and can attest to the fact that he did not get a copy of the report from me. I cannot attest to the accuracy of Mr. Moore's statements concerning his independent recollection of events.

I have read all of the foregoing and find it to be true and accurate to the best of my knowledge.

L. Michael Weeks

L. Michael Weeks

Subscribed and sworn to before me ______________________

13th day of November, 1986.

Barbara J. Webb
Notary Public
District of Columbia

[illegible], 1990

July 24 Hearing—Appendix 2

NASA

National Aeronautics and
Space Administration

Washington, D.C.
20546

Reply to Attn of: C:MDD:C-19807f

SEP 18 1986

Honorable Robert A. Roe
Chairman
House Committee on Challenger Accident
Committee on Science and Technology
House of Representatives
Washington, DC 20515

Dear Mr. Chairman:

Enclosed is the material requested for the record on page 143 during the July 24, 1986, hearing at which Dr. Fletcher testified on the Challenger accident.

This material completes the information requested during that hearing.

Sincerely,

Lynn W. Heninger

Lynn W. Heninger
Director, Congressional Liaison Division

Enclosures

Material requested for the record on page 143, line 3396 by Chairman Roe during the July 24, 1986, hearing.

In March 1986 the National Space Transportation System initiated a series of special Program Requirements Control Board (PRCB) reviews of critical Space Shuttle systems and components. These reviews, called System Design Reviews (SDR's), were and are intended to highlight areas of potential flight safety improvement and/or redesign in the Space Shuttle system based upon the experience and knowledge of government and contractor system engineers working across the program. While it was fully expected that the formal program-wide FMEA/CIL re-review, which is underway in response to Admiral Richard H. Truly's Strategy for Safely Returning the Space Shuttle to Flight Status and to the Presidential Commission's recommendations, will comprehensively identify critical system areas for potential redesign, the FMEA/CIL review is a very large scale undertaking which will take a number of months to complete. The premise for the SDR review series is that most areas where technical issues may exist with respect to subsystem performance and safety are already known to the various technical specialists and engineers across the program and, in fact, many of these issues have been previously reviewed and dispositioned at an earlier time. Thus, the SDR series was initiated to achieve up-front program visibility, action, and schedule lead-time on important areas of potential Space Shuttle system redesign.

To date, the program has conducted 22 SDR meetings; the first was held on March 26, 1986, and the most recent on August 5, 1986. Issues and proposed changes have been presented by appropriate elements of the Johnson Space Center, the Marshall Space Flight Center, the Kennedy Space Center, the Vandenberg Launch Site, and their contractors. Two hundred fifty-four candidate hardware, software, and analysis actions have been considered by the board. Of these, 95 have been approved for implementation/completion before the next STS flight, 36 have been approved for expedited implementation down-stream of the first flight, 18 have been transferred to normal program change channels and 55 were combined with other changes. The remaining 50 are still being assessed for specific implementation priority. A complete listing of all open and closed SDR actions is enclosed.

NATIONAL SPACE TRANSPORTATION SYSTEM

SYSTEM DESIGN REVIEW BOARD

SYSTEM DESIGN REVIEW ISSUES

LEVEL II ACTION ITEMS

8/12/86

Manager, National Space Transportation System

NATIONAL SPACE TRANSPORTATION SYSTEM

SYSTEM DESIGN REVIEW BOARD

SYSTEM DESIGN REVIEW ISSUES

LEVEL II ACTION ITEMS

OPEN ACTIONS

PAGE NO. 1
DATE 08/11/86

REPORT NO. 2102-1

S D R I   S T A T U S
CATEGORY 1 OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
33444 R2	1 1	MOD ET T-0 UMBILICAL STATIC LANYARD TO ASSURE CLEARANC	KSC-NE 1-1 S	IMPLEMENT IN YOUR PROJECT THE FOLLOWING ET GH2 VENT SYSTEM MODIFICATIONS: (CATEGORY 1) 1)REDESIGN OF AFT PIVOT TRUNNION, LENGTHENING OF THE PIVOT ARM & INCREASING FORWARD FLEX HOSE FLEXIBILITY. 2)T-0 INITIATED SECONDARY LANYARD DISCONNECT & RETRIEVAL SYSTEM 3)THERMAL PROTECTION FOR VENT LINE & QICK DISCONNECT 4)REDUNDANT VENT LINE RETRACT LATCH 5)LETF SECONDARY DISCONNECT CAPABILITY TO REQUALIFY SYSTEM.	11/14/87 JSC-TA	
	1 1		KSC-GM 1-2 S		11/14/87 JSC-TA	

PAGE NO. 2
DATE 08/11/86

REPORT NO. 2102-1

S D R I   S T A T U S
CATEGORY 1 OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
33444 R2	1 1		USAF-VLS 2-1 S	IMPLEMENT IN YOUR ACTI VITY THE FOLLOWING ET GH2 VENT SYSTEM MODIFI- CATIONS: (CATEGORY 1) 1)REDESIGN OF AFT PIVOT TRUNNION, LENGTHENING OF PIVOT ARM & INCREASING FORWARD FLEX HOSE FLEXI- BILITY 2)T-0 INITIATED SECONDARY LANYARD DIS- CONNECT & RETRIEVAL SYS 3)THERMAL PROTECTION FOR VENT LINE & QUICK DIS- CONNECT 4)REDUNDANT VENT LINE RETRACT LATCH 5)LETF SECONDARY DISCON- NECT CAPABILITY TO REQUALIFY SYSTEM	11/14/87 JSC-TA	
	1 1		JSC-TE 2-2 S		11/14/87 JSC-TA	

REPORT NO. 2102-1

S D R I   S T A T U S
CATEGORY 1 OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60001 R2	1 1	17-INCH UMBILICAL DISCONNECT VALVE REDESIGN	JSC-VA 1-1 S	DEVELOP OPTIONS OR CONCEPTS FOR A 17-INCH UMBILICAL DISCONNECT WITH NO ACTIVE COMPONENT WITHIN THE PROPELLANT FLOW STREAM. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1.	06/12/86 JSC-AM	
	1 1		JSC-EA 1-2 S		07/11/86 JSC-AM	
	1 1		JSC-VA 2-1 S	REVIEW/DEFINE STATUS OF VALVE REDESIGN STUDY. INCLUDE CONSIDERATIONS OF INCORPORATION OF A LATCH FEATURE IN THE EXISTING VALVE DESIGN AS WELL AS TOTAL REDESIGN OF THE VALVE. DEVELOP COST AND SCHEDULE IMPACT AND REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1	06/12/86 JSC-AM	

REPORT NO. 2102-1

S D R I S T A T U S
CATEGORY 1 OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60001 R2	1 1		JSC-EA 2-2 S		06/12/86 JSC-AM	
	1 1		JSC-VA 3-1 S	REVIEW PREVIOUS WORK, INCLUDING CERTIFICATION ACTIVITIES, RELATIVE TO PROBLEMS WITH DISCONNECT TIP LOADS AND FLAPPER ANGLE SETTINGS. DEVELOP A POSITION ON PERFORMANCE MARGINS AND PROPOSED CHANGES IN SPECIFICATIONS THAT WOULD PRECLUDE WAIVERS FOR FUTURE FLIGHTS. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1.	06/12/86 JSC-AM	

REPORT NO. 2102-1

S D R I S T A T U S
CATEGORY 1 OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60001 R2	1 1		JSC-GA/M 4-1 S	WITH THE ORBITER CONTRACTOR SAFETY ORGANIZATIONS DEVELOP A PLAN TO ADDRESS THE CURRENT SR&QA POSITION REGARDING THE 17-INCH DISCONNECT DESIGN AND FIXES IN THE AREAS OF PROCEDURES OR TOOLS TO ASSURE THAT THE VALVES OPERATE WITHOUT THREAT TO FLIGHT SAFETY. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1.	06/12/86 JSC-AM	
	1 1		JSC-VA 4-2 S		06/12/86 JSC-AM	

REPORT NO. 2102-1

S D R I   S T A T U S
CATEGORY 1 OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60001 R3	1 1	17-INCH UMBILICAL DISCONNECT VALVE REDESIGN	JSC-VA 1-1 S	REVIEW FAILURE MODES, INCLUDING PNEUMATIC AND ELECTRONIC, IDENTIFIED IN CIL/FMEA THAT COULD CAUSE UNDESIRED CLOSURE OF THE 17-INCH UMBILICAL DISCONNECT VALVE. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1.	07/11/86 JSC-AM	
	1 1		JSC-VA 2-1 S	REVIEW THE DESIGN OF THE 17-INCH UMBILICAL DISCONNECT SEAL LEAK TEST PORT AND THE PROCEDURES FOR PERFORMING LEAK CHECKS, AND VERIFY THAT THERE ARE NO RELATED SAFETY CONCERNS. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1.	07/11/86 JSC-AM	

REPORT NO. 2102-1

S D R I S T A T U S
CATEGORY 1 OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60001 R3	1 1		JSC-VA 3-1 S	DETERMINE CERTIFICATION STATUS OF 17-INCH UMBILICAL DISCONNECT SECONDARY SEAL. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1	07/11/86 JSC-AM	
	1 1		JSC-VA 4-1 S	INVESTIGATE THE AVAILABILITY AND POSSIBLE UTILIZATION OF ADDITIONAL RESOURCES AND MANPOWER FOR RESOLUTION OF 17-IN UMBILICAL DISCONNECT CONCERNS. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1	07/11/86 JSC-AM	
	1 1		JSC-VA 5-1 S	PROVIDE STATUS OF ALL ON-GOING ACTIVITIES RELATED TO 17-INCH UMBILICAL DISCONNECT CONCERNS. CATEGORY 1.	07/11/86 JSC-AM	

REPORT NO. 2102-1

SDRI STATUS
CATEGORY 1 OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60002 R3	1	GO2 FLOW CONTROL VALVE PARTICLE IMPACT EFFECTS	JSC-VA 1-1 S	INSPECT THE GO2 FLOW CONTROL VALVE HAVING THE MOST TIME LOGGED TO ENSURE FRETTING HAS NOT DEGRADED PERFORMANCE. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB. CATEGORY 1.	06/12/86 JSC-AM	
60002 R4	1	GO2 FLOW CONTROL VALVE PARTICLE IMPACT EFFECTS	JSC-VA 1-1 S	PROCEED WITH PARTICLE IMPACT TESTING AT WHITE SANDS ON THE EXISTING DESIGN GO2 FLOW CONTROL VALVES, INCLUDING OUTLET LINES AND THE FLOW MANIFOLD. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1.	07/07/86 JSC-AM	106000
	1		JSC-EA 1-2 S		07/07/86 JSC-AM	106000

REPORT NO. 2102-1

SDRI STATUS
CATEGORY 1 OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60004 R2	1 1	ANTI-SLAM PREVLAVE SINGLE POINT FAILURES & SAFE SHUTDOWN	MSFC-SSME 1-1 S	DETERMINE REQUIREMENTS TO SUPPORT CONDUCTING A ZERO-G SHUTDOWN TEST. SUBSEQUENT TO COMPLETION OF THESE DETERMINATIONS, PROCEED WITH PERFORMING A SAFE SHUTDOWN TEST IN SIMULATED ZERO-G CONDITIONS (FOR LOX ONLY). REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1.	07/11/86 JSC-AM	
	1 1		JSC-VA 2-1 S	CONDUCT AN LO2 PREVALVE TEST TO DETERMINE THE SENSITIVITY TO ANTI-SLAM PREVALVE LEAKAGE. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1.	07/11/86 JSC-AM	

REPORT NO. 2102-1

S D R I   S T A T U S
CATEGORY 1 OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60004 R2	1 1		MSFC-SSME 3-1 S	ANALYZE ENGINE SHUTDOWN HARDWARE/PROCEDURES TO DETERMINE IMPROVED METHODS OF DEFENSING AGAINST FAILURES. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1.	07/11/86 JSC-AM	
	1 1		JSC-VA 4-1 S	ANALYZE ORBITER HARDWARE /PROCEDURES TO DETERMINE IMPROVED METHODS OF DEFENSING AGAINST SSME SHUTDOWN FAILURES. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1.	07/11/86 JSC-AM	
	1 1		JSC-TE 5-1 S	WITH THE PSIG, ASSESS REDUNDANCY ISSUE/SINGLE POINT FAILURES IN ALL ELEMENTS OF THE SHUTDOWN SYSTEM. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1.	07/11/86 JSC-AM	

REPORT NO. 2102-1

S D R I   S T A T U S
CATEGORY 1 OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60005 R1	1 1	GSE SCREEN FOR PRO PELLANT FILL/DRAIN SYSTEM INLETS	JSC-TE 1-1 S	WITH THE PSIG, ASSESS KSC-SE GSE SCREEN RE- COMMENDATIONS FOR LO2 AND LH2 VALVES AND REVIEW DESIGN/CERTIFICA- TION REQUIREMENTS. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1.	06/12/86 JSC-AM	
	1 1		KSC-SE 2-1 S	IMPLEMENT IN YOUR ACTIVITY PROVISION OF A GSE SCREEN ON BOTH THE H2 AND O2 SIDES NEAR THE VEHICLE INLETS TO THE PROPELLANT FILL AND DRAIN SYSTEMS FOR BOTH KSC AND VLS. CATEGORY 1	06/12/86 JSC-AM	
	1 1		USAF-VLS 2-2 S		06/12/86 JSC-AM	

REPORT NO. 2102-1

S D R I S T A T U S
CATEGORY 1 OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60006 R2	1	ET ULLAGE PRESSURE TRANSDUCER STICTION PROBLEMS	JSC-VA 1-1 S	IMPLEMENT S/W CHANGE REQUEST 79917 (IN-FLIGHT /GROUND SWITCH) IN YOUR PROJECT. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1.	07/11/86 JSC-AM	
	1		JSCGA/OASCB 1-2 S		07/11/86 JSC-AM	
60008 R2	1 1	SSME PERFORMANCE DATA CONFIDENCE	MSFC-SSME 1-1 S	PERFORM ANALYSIS AND/OR TEST TO OBTAIN ENHANCED SSME OFF-NOMINAL OPERATION PERFORMANCE DATA, INCLUDING HYDRAULIC LOCK UP AND CHAMBER PRESSURE SENSOR SHIFT TESTING. THE RESULTING DATA WILL BE USED TO UPDATE THE ARD. REPORT RESULTS TO SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1.	07/11/86 JSC-AM	
	1 1		JSC-DA 1-2 S		07/11/86 JSC-AM	

REPORT NO. 2102-1

SDRI STATUS
CATEGORY 1 OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60008 R2	1 1		JSC-TA 1-3 S		07/11/86 JSC-AM	
	1 1		MSFC-SSME 2-1 S	PROVIDE BUDGET AND ENGINE TEST PLANNING IMPACTS TO OBTAIN ENHANCED SSME OFF NOMINAL OPERATION PERFORMANCE DATA FROM HYDRAULIC LOCKUP AND CHAMBER PRESSURE(PC) SENSOR SHIFT TESTING. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1.	07/11/86 JSC-AM	
	1 1		MSFC-SSME 3-1 S	VERIFY VALIDITY OF CURRENTLY AVAILABLE OFF-NOMINAL OPERATIONS DATA PENDING RECEIPT OF NEW TEST DATA. ALSO PROVIDE REVISION OF CURRENT DATA AS NEEDED, TO REFLECT PHASE II ENGINE OPERATION. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).CATEGORY 1	07/11/86 JSC-AM	

REPORT NO. 2102-1

S D R I   S T A T U S
CATEGORY 1 OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60008 R2	1 1		MSFC-SSME 4-1 S	DEVELOP RECOMMENDATION OF APPROPRIATE TESTS TO ASSURE HIGHEST FIDELITY LEVEL OF DATA SUBMITTED. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1.	07/11/86 JSC-AM	
60009 R1	1 1	SSME REDLINE VERIFICATION	MSFC-SSME 1-1 S	PERFORM ANALYSIS AND/OR TEST TO VERIFY REDLINES FOR SPECIFIED SSME PRESSURE/TEMPERATURE MEASUREMENTS RELATIVE TO SAFE SHUTDOWN ASSURANCE OR INADVERTENT SHUTDOWN PRECLUSION. THESE ACTIVITIES SHALL ENCOMPASS HYDRAULIC LOCKUP CONSIDERATIONS AND TESTING AS APPROPRIATE. CATEGORY 1.	07/11/86 JSC-AM	
	1 1		JSC-DA 1-2 S		07/11/86 JSC-AM	

REPORT NO. 2102-1

S D R I S T A T U S
CATEGORY 1 OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60009 R1	1 1		JSC-EA 1-3 S		07/11/86 JSC-AM	
	1 1		MSFC-SSME 2-1 S	RE-ASSESS EXISTING RED-LINES AND THEIR DERIVATIONS WITH RESPECT TO THIS SDRI. REPORT RESULTS AND PROVIDE RE-COMMENDATIONS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1.	07/11/86 JSC-AM	
	1 1		JSC-DA 2-2 S		07/11/86 JSC-AM	
	1 1		JSC-EA 2-3 S		07/11/86 JSC-AM	
60011 R1	1 1	THIRD TURBINE DISCHARGE TEMPERATURE REDLINE SENSOR	MSFC-SSME 1-1 S	IMPLEMENT IN YOUR PRO-JECT THE ADDITION OF A THIRD REDLINE SENSOR IN BOTH THE HPFTP AND THE HPOTP AND ISSUE APPRO-PRIATE DIRECTION TO YOUR CONTRACTOR. CATEGORY 1.	07/11/86 JSC-AM	

REPORT NO. 2102-1

S D R I   S T A T U S
CATEGORY 1 OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60011 R1	1 1		JSC-DA 2-1 S	DETERMINE BEST SOFTWARE IMPLEMENTATION INCLUDING DETAILED DOWNLIST CHANGES. REPORT RE-COMMENDATION TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1.	07/11/86 JSC-AM	
	1 1		JSC-VA 2-2 S		07/11/86 JSC-AM	
	1 1		JSCGA/OASCB 3-1 S	DEVELOP MANPOWER/SCHEDULE/COST AND OTHER IMPACTS ASSOCIATED WITH THIS CHANGE IN CONJUNCTION WITH AN OVERALL AVIONICS SOFTWARE REVIEW. RECOM-MENDATIONS REGARDING THIS CHANGE WILL BE DE-VELOPED BY THE OASCB. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1.	07/11/86 JSC-AM	
	1 1		JSC-VA 3-2 S		07/11/86 JSC-AM	

REPORT NO. 2102-1

S D R I S T A T U S
CATEGORY 1 OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60011 R2	1 1	THIRD TURBINE DISCHARGE TEMP REDLINE SENSOR	MSFC-SSME 1-1 S	PROVIDE MODIFICATION HARDWARE AND ENGINEERING TO ACCOMPLISH THE ADDITION OF A THIRD REDLINE SENSOR IN BOTH THE HPFTP AND THE HPOTP. SUBMIT TO THE LEVEL II PRCB FOR MODIFICATION IMPLEMENTATION IN OV-102. CATEGORY 1.	09/01/86 JSC-AM	
	1 1		MSFC-SSME 1-2 S		09/01/86 JSC-AM	
	1 1		MSFC-SSME 1-3 S		09/01/86 JSC-AM	
60012 R1	1 1	SRB NOZZLE EROSION	MSFC-SRB 1-1 S	DEVELOP RE-DESIGN TO ELIMINATE SRM NOZZLE EROSION AND "POCKETING". REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1.	07/11/86 JSC-AM	

REPORT NO. 2102-1

S D R I S T A T U S
CATEGORY 1 OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60012 R1	1 1		JSC-GA/M 2-1 S	INCLUDE SDRI #SB0012 IN CIL/FMEA REVIEW. CATEGORY 1.	07/11/86 JSC-AM	
60016 R3	1 1	RCS REGULATOR CONT AMINATION	JSC-VA 1-1 S	IDENTIFY THE SOURCE OF CONTAMINATION IN THE RCS REGULATOR AND IMPLE- MENT APPROPRIATE CONTROL PROCEDURES. CATEGORY 1.	07/11/86 JSC-DA	
	1 1		KSC-SM 1-2 S		07/11/86 JSC-DA	
	1 1		JSC-VA 2-1 S	INCREASE THE PROPELLANT TANK PRESSURE SAMPLE RATE DURING REGULATOR CHECK OUT IN OPS 1 AND 9 REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1.	07/11/86 JSC-DA	

REPORT NO. 2102-1

S D R I S T A T U S
CATEGORY 1 OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60016 R3	1 1		KSC-SM 3-1 S	REVIEW ACTIVITIES ASSO-CIATED WITH FERRY FLIGHT INCLUDING PREPARATION THE ACTUAL FERRY FLIGHT AND POST FLIGHT ACTIVI-TIES CONCENTRATING ON POSSIBLE INTRODUCTION OF MOISTURE CONTAMINATION INTO THE RCS REGULATORS. REPORT RESULTS AND RECOM MENDATIONS TO THE SPE-CIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1.	07/11/86 JSC-DA	
	1 1		JSC-VA 3-2 S		07/11/86 JSC-DA	
	1 1		KSC-SM 4-1 S	REVIEW GSE AND PROCEDURE FOR ALL POSSIBLE SOURCES OF CONTAMINATION. COM-PARE RESULTS WITH WSTF AVAILABLE DATA. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1.	07/11/86 JSC-DA	

REPORT NO. 2102-1

SDRI STATUS
CATEGORY 1 OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60018 R2	1 1	NO YAW JET MODE UP GRADE/CERTIFICATIO N	JSC-VA 1-1 S	PERFORM CERTIFICATION OF NO YAW JET DOWNMODE CAPABILITY. CATEGORY 1	07/25/86 JSC-DA	
	1 1		JSC-VA 2-1 S	IMPLEMENT CR 79616, NO YAW JET DOWNMODE, PENDING FINAL OASCB APPROVAL. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1.	07/25/86 JSC-DA	
60020 R2	1	OMS/RCS AC MTR VLV BLLWS LEAK CAUSE M MH VAPOR DETONT	JSC-VA 1-1 S	PERFORM PROPELLANT EX-POSURE TESTS WITH CON-TINUOUS VALVE POWER APPLIED TO THE MOTOR ACTUATORS. REPORT RE-SULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW). CATEGORY 1.	07/11/86 JSC-DA	
60021 R1	1	RCS CROSSFEED MCA OPTIMIZATION	JSC-VA 1-1 S	IMPLEMENT SOFTWARE CHANGE REQUEST 59126H IN YOUR PROJECT. CATEGORY 1.	07/11/86 JSC-DA	

PAGE NO. 21
DATE 08/11/86

REPORT NO. 2102-1

S D R I   S T A T U S
CATEGORY 1 OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60021 R1	1		JSC-DA 2-1 S	REASSESS REQUIREMENT FOR PROPELLANT DUMPS DURING ABORT MODES. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1.	07/11/86 JSC-DA	
60025 R2	1 1	GRTLS ET SEPARATION JET REQUIREMENTS	JSC-TE 1-1 S	ASSESS THIS ISSUE TO VERIFY THAT A PROBLEM EXISTS. IF IT DOES, PRECISELY DEFINE PROBLEM & DEVELOP PLAN FOR RESOLVING PROBLEM, ENSURING THAT PROPOSED SOLUTION DOES NOT INTRODUCE OTHER UNDESIRED CONDITIONS. JSC-TE DIRECT YOUR CONRACTOR ACCORDINGLY. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1	07/11/86 JSC-DA	
	1 1		JSC-EA 1-2 S		07/11/86 JSC-DA	

REPORT NO. 2102-1

S D R I   S T A T U S
CATEGORY 1 OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60025 R2	1 1		JSC-VA 1-3 S		07/11/86 JSC-DA	
	1 1		JSC-EA 2-1 S	REVIEW AERO DATA BASE TO EVALUATE EXPANSION CAPABILITY REGARDING GRTLS ET-SEP CAPABILITY. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1.	07/11/86 JSC-DA	
	1 1		JSC-VA 3-1 S	IMPLEMENT THE REQUIRED SOFTWARE FOR THE AFT RCS TO PARTIALLY RESOLVE THIS ISSUE. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1.	07/11/86 JSC-DA	
60026 R3	1 1	REVERSE WEIGHT-ON-WHEELS LOGIC	JSC-VA 1-1 S	IMPLEMENT IN YOUR PROJECT SCR'S 69098F AND 69955.	08/15/86 JSC-DA	

PAGE NO. 23
DATE 08/11/86

REPORT NO. 2102-1

SDRI STATUS
CATEGORY 1 OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60027 R2	1 1	MDM ANALOG-TO-DIGITAL CONVERSION FAILURE	JSC-VA 1-1 S	SUBMIT AND IMPLEMENT APPROPRIATE SOFTWARE CHANGE REQUEST FOR RESOLVING MDM FAILURES RELATIVE TO CONTROLLERS (RHC'S, SBTC'S & RPTA'S) REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1.	07/13/86 JSC-DA	
	1 1		JSCGA/OASCB 1-2 S		07/13/86 JSC-DA	

REPORT NO. 2102-1

SDRI STATUS
CATEGORY 1 OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60027 R2	1 1		JSC-VA 2-1 S	IMPLEMENT APPROPRIATE CHANGES TO ACHIEVE SRB RGA RECHANNELIZATION TO PROVIDE 2 FAULT TOLERANCE. FOUR RGA'S WILL BE WIRED TO DIFFERENT FLIGHT CRITICAL AFT MDM'S FOR ISOLATION/ REDUNDANCY. THE REDUNDANCY MGMT SOFTWARE WILL BE MODIFIED TO BE A FOUR LRU SELECTION FILTER. SRB RGA POWER CHANNELIZATION WILL ALSO BE MODIFIED TO ACCOMODATE DUAL ORBITER POWER FAILURES. CATEGORY 1	07/25/86 JSC-DA	
	1 1		JSC-EA 2-2 S		07/25/86 JSC-DA	
	1 1		JSC-DA 2-3 S		07/25/86 JSC-DA	
	1 1		MSFC-SRB 2-4 S		07/25/86 JSC-DA	

REPORT NO. 2102-1

S D R I S T A T U S
CATEGORY 1 OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60027 R3	1 1	MDM ANALOG-TO-DIGITAL CONVERSION FAILURE	JSC-VA 1-1 S	PERFORM DETAILED TECHNICAL REVIEW OF SRB RGA RECHANNELIZATION TO PROVIDE 2 FAULT TOLERANT CAPABILITY AND PROVIDE APPROPRIATE IMPACTS. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1.	08/15/86 JSC-DA	
	1 1		MSFC-SRB 1-2 S		08/15/86 JSC-DA	
	1 1		JSC-GA/M 2-1 S	DEVELOP PROGRAM REQUIREMENT FOR CONDUCTING SYSTEM LEVEL FMEA. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1.	08/15/86 JSC-DA	

REPORT NO. 2102-1

SDRI STATUS
CATEGORY 1 OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60027 R3	1 1		JSC-TE 3-1 S	REVIEW MOUNTING TECHNIQUE FOR SRB RGS'S TO ALLOW ADDED PROTECTION AGAINST SHOCK. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1.	08/15/86 JSC-DA	
	1 1		JSC-VA 4-1 S	ASSESS CREDIBILITY OF MDM ANALOG-TO-DIGITAL CONVERSION FAILURES RELATIVE TO CONTROLLERS (RHC, SBTC'S AND RPTA'S) REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1.	08/15/86 JSC-DA	
60027 R4	1 1	MDM ANALOG-TO-DIGITAL CONVERSION FAILURE	JSC-VA 1-1 S	PROVIDE MODIFICATION HARDWARE AND ENGINEERING TO ACCOMPLISH SRB RGA RECHANNELIZATION. SUBMIT TO THE LEVEL II PRCB FOR MODIFICATION IMPLEMENTATION IN OV-102. CATEGORY 1.	09/01/86 JSC-DA	

REPORT NO. 2102-1

S D R I   S T A T U S
CATEGORY 1 OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60027 R4	1 1		JSC-VA 1-2 S		09/01/86 JSC-DA	
	1 1		JSC-VA 1-3 S		09/01/86 JSC-DA	
60028 R1	1 1	SSME DUMP/STOW CON CERNS	JSCGA/OASCB 1-2 S	IMPLEMENT IN YOUR PRO- JECT SOFTWARE CHANGE RE- QUEST 79584C TO DUMP REMAINING MPS PROPEL- LANTS THROUGH THE SSMES IN THE STOW POSITION. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY I	07/11/86 JSC-DA	

REPORT NO. 2102-1

SDRI STATUS
CATEGORY 1 OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60029 R3	1	APU ISOLATION VALVE CONCERNS	JSC-VA 1-1 S	PROCEED WITH ENGINEERING AND HARDWARE DEVELOPMENT RELATIVE TO IMPROVED INSTRUMENTATION ON APU ISOLATION VALVES. PROVIDE A SPECIFIC PLAN FOR IMPLEMENTATION OF IMPROVED INSTRUMENTATION, INCLUDING CHANNELIZATION AND POSSIBLE ELECTRICAL INTERRUPTION, AND ASSOCIATED IMPACTS. INCLUDE ASSESSMENT OF INCREASING INSTRUMENTATION FOR SINGLE OR REDUNDANT COVERGE ON BOTH SOLENOIDS AS OPPOSE TO ONE SOLENOID.RPT TO SP PRCB (SDRB).CAT 1.	07/07/86 JSC-AM	2148000
60029 R4	1	APU ISOLATION VALVE CONCERNS	JSC-VA 1-1 S	PROCEED WITH THE PRELIMINARY EFFORT REQUIRED FOR PROCUREMENT OF A REDESIGNED APU ISOLATION VALVE.ISSUE APPROPRIATE DIRECTION TO YOUR CONTRACTOR. CATEGORY 1	08/11/86 JSC-AM	

REPORT NO. 2102-1

S D R I S T A T U S
CATEGORY 1 OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60031 R3	1 1	ENTRY WITH SINGLE APU	JSC-VA 1-1 S	DEVELOP PLAN DEFINING REQUIREMENTS NECESSARY TO CERTIFY ENTRY WITH A SINGLE APU. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1.	08/15/86 JSC-AM	
	1 1		JSC-TE 1-2 S		08/15/86 JSC-AM	
	1 1		JSC-EA 1-3 S		08/15/86 JSC-AM	
	1 1		JSC-VA 2-1 S	DIRECT YOUR CONTRACTOR TO PROVIDE A FORMAL POSITION RELATIVE TO SINGLE APU ENTRY CERTIFICATION.	08/15/86 JSC-AM	

REPORT NO. 2102-1

S D R I   S T A T U S
CATEGORY 1 OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60033 R1	1 1	ENTRY WITH PAYLOAD BAY DOOR LATCHES OUT	JSC-VA 1-1 S	DETERMINE ORBITER CAPABILITY TO SAFELY ENTER WITH PAYLOAD BAY DOOR LATCHES OPEN. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1.	07/11/86 JSC-DA	
	1 1		JSC-VA 2-1 S	RE-EVALUATE CENTERLINE LATCH ISSUE IN THE OVERALL CIL/FMEA ITEMS REVIEW. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1	07/11/86 JSC-AM	
60034 R1	 1	UNCOMMANDED BRAKE PRESSURE	JSC-VA 1-1 S	REVIEW SODB AND UPDATING PROCEDURES/PROCESSES TO ENSURE THAT IT CONTAINS CURRENT, ACCURATE, AND VALIDATED DATA. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1.	07/11/86 JSC-AM	

REPORT NO. 2102-1

S D R I S T A T U S
CATEGORY 1 OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60034 R1	1		JSC-EA 1-2 S		07/11/86 JSC-AM	
	1		JSC-DA 1-3 S		07/11/86 JSC-AM	
60035 A	1	ORBITER ARRESTING SYSTEM PROCUREMENT	JSC-TM 2-1 S	WORKING WITH BOTH POTENTIAL CONTRACTORS, DEVELOP COMMON DESIGN CRITERIA FOR ORBITER ARRESTING SYSTEM FOOTING SO THAT FOOTINGS CAN BE POURED PRIOR TO DEPARTURE OF CONSTRUCTION CONTRACTOR FROM EASTER ISLAND. REPORT RESULTS TO LEVEL II PRCB. CATEGORY 1	07/21/86 JSC-TA	
	1		KSC-NE 2-2 S		07/21/86 JSC-TA	

REPORT NO. 2102-1

S D R I   S T A T U S
CATEGORY 1 OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60035 A	1		JSC-TM 3-1 S	PROVIDE APPROPRIATE DATA TO NASA HQ FOR STATE DEPARTMENT NEGOTIATIONS OF ORBITER ARRESTING SYSTEM INSTALLATIONS. CATEGORY 1	07/21/86 JSC-TA	
	1		JSC-VA 4-1 S	DEVELOP DESIGN OF WEB-BING CUTTER FOR ORBITER NOSE WHEEL LANDING GEAR. SUBMIT DESIGN APPROACH AND IMPACTS TO THE LEVEL II PRCB. CATEGORY 1	07/21/86 JSC-TA	
60035 R1	1	LANDING/DECELERATION SYSTEM CAPABILITY	JSC-VA 1-1 S	PROCEED WITH DEVELOPMENT AND IMPLEMENTATION OF IMPROVED AXLE AND STATOR MODS RELATIVE TO BRAKES. CATEGORY 1.	06/12/86 JSC-AM	

REPORT NO. 2102-1

S D R I S T A T U S
CATEGORY 1 OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60035 R1	1		JSC-VA 10-1 S	REPORT STATUS/RESULTS OF CURRENT KSC RUNWAY SURFACE EVALUATION AND DETERMINE ESTIMATED TIME OF COMPLETION OF ALL STUDY ACTIVITY. INCLUDE COST & SCHEDULE IMPACTS OF IMPLEMENTING RECOMMENDED MODIFICATIONS. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1.	06/12/86 JSC-AM	
	1		JSC-AE 10-2 S		06/12/86 JSC-AM	
	1		KSC-NE 10-3 S		06/12/86 JSC-AM	
	1		LARC 10-4 S		06/12/86 JSC-AM	

REPORT NO. 2102-1

S D R I   S T A T U S
CATEGORY 1 OPEN ACTIONS

PLIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60035 R1	1		JSC-VA 12-1 S	IMPLEMENT TIRE PRESSURE MONITORING SYSTEM. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1.	06/12/86 JSC-AM	
	1		JSC-VA 14-1 S	ASSESS THE REQUIREMENT FOR AN ANTI-SKID BRAKING SYSTEM. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1	06/12/86 JSC-AM	
	1		JSC-VA 15-1 S	DEVELOP ALTERNATE ELEVON SCHEDULING CONCEPTS TO MEET OPERATIONAL REQUIREMENTS DEFINED BY JSC-CA AND JSC-DA. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).CATEGORY 1	06/12/86 JSC-AM	
	1		JSC-EA 15-2 S		06/12/86 JSC-AM	

REPORT NO. 2102-1

SDRI STATUS
CATEGORY 1 OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60035 R1	1		JSC-VA 2-1 S	DEFINE IMPLEMENTATION FOR ANTI-SKID SYSTEM WHICH DOES NOT RESULT IN BRAKE PRESSURE REDUCTION BY HALF IN THE EVENT OF A BLOWN TIRE. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1.	06/12/86 JSC-AM	
	1		JSC-VA 3-1 S	IMPLEMENT FLIGHT S/W CHANGES, IN THE ORBITER NWS, IDENTIFIED DURING RECENT AMES SIMULATION WHICH INCORPORATED THE LATEST MLG TIRE MODEL. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1.	06/12/86 JSC-AM	
	1		JSC-VA 3-2 S		06/12/86 JSC-AM	

REPORT NO. 2102-1

SDRI STATUS
CATEGORY 1 OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60035 R1	1		JSC-CA 7-1 S	INVESTIGATE OPERATIONAL IMPACTS OF ELEVON SCHE-DULING, I.E., HANDLING CHARACTERISTICS DURING ROLLOUT ON THE MLG, NLG AND BRAKES. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1.	06/12/86 JSC-AM	
	1		JSC-DA 7-2 S		06/12/86 JSC-AM	
60035 R3	1	LANDING/DECELERATION SYSTEM CAPABILITY	JSC-VA 7-1 S	DETERMINE ALTERNATE BOLT TENSION MEASUREMENTS TECHNIQUES AND REVIEW CURRENT KSC PROCEDURES TO SET-UP WHEELS. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1	07/11/86 JSC-AM	
	1		KSC-NE 7-2 S		07/11/86 JSC-AM	

REPORT NO. 2102-1

S D R I S T A T U S
CATEGORY 1 OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60035 R4	1	LANDING/DECELERATION SYSTEM CAPABILITY	JSC-VA 1-1 S	IDENTIFY PROCEDURES, INCLUDING SPECIFIC TEST CONFIGURATIONS, PLANNED/REQUIRED TO VERIFY THAT A 55 MVP BRAKE CAPABILITY WILL BE AVAILABLE FOR FIRST FLIGHT. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1.	08/15/86 JSC-AM	
60035 R5	1	LANDING/DECELERATION SYSTEM CAPABILITY	JSC-VA 1-1 S	DEVELOP IMPACTS AND DETERMINE FEASIBILITY OF A ROLL-ON-RIM CAPABILITY FOR FIRST REFLIGHT ORBITER LANDING. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1.	11/15/86 JSC-AM	

REPORT NO. 2102-1

S D R I   S T A T U S
CATEGORY 1 OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60036 R2	1	LOSS OF WATER REMOVAL CAPABILITY FOR FUEL CELLS	JSC-VA 1-1 S	DEVELOP A CONCEPT TO SEPARATE THE RELIEF WATER FLOW FROM THE THREE FUEL CELLS INTO MULTIPLE FLOW PATHS WHICH DO NOT FLOW THROUGH A SINGLE WATER RELIEF PANEL. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1.	07/11/86 JSC-AM	
	1		JSC-EA 1-2 S		07/11/86 JSC-AM	
60039 R1	1 1	EMRGNCY EGRESS ESC PNL NO OPN UNDR POST LNDNG PRESS DIF	JSC-VA 1-1 S	COMPLETE CERTIFICATION OF THE MODIFIED/IMPROVED BUNGEE SYSTEM FOR THE EMERGENCY EGRESS PANEL. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1.	12/12/86 JSC-DA	

REPORT NO. 2102-1

S D R I S T A T U S
CATEGORY 1 OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60040 R2	1 1	LACK OF VIABLE CRW ESCAPE RTE TO SLDW RE LNCH PAD FIRE	KSC-GM 1-1 S	REASSES CONSIDERATIONS RELATIVE TO A VIABLE SLIDEWIRE ESCAPE ROUTE IN CASE OF FIRE ON THE LAUNCH PAD AND RE-EVAL-UATE RELIABILITY OF THE CURRENT FIRE DETECTION SYSTEM INCLUDING ADD-ITION OF TEMPERATURE MEASUREMENTS. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1.	02/14/87 KSC-GSE	
	1 1		USAF-VLS 1-2 S		02/14/87 KSC-GSE	

REPORT NO. 2102-1

S D R I   S T A T U S
CATEGORY 1 OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60041 A	1 1	CREW ESCAPE CAPABILITY FROM LIFTOFF THROUGH ROLLOUT	JSC-VA 1-1 S	IMPLEMENT ROM ASSESSMENT STUDIES WITH THE ORBITER CONTRACTOR TO DEFINE DETAILED WEIGHT, COST AND SCHEDULE REQUIREMENTS FOR BOTH MANUAL AND POWERED BAILOUT/EXTRACTION SYSTEMS CONSIDERING EACH OF THE OPTIONS PRESENTED ON JUNE 30, 1986 AND ANY OTHER VARIANTS CONSIDERED FEASIBLE. REPORT RESULTS TO THE LEVEL II PRCB. (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1.	07/31/86 JSC-GA	
	1 1		JSC-VA 2-1 S	INITIATE ENGINEERING STUDIES TO DETERMINE THE FEASIBILITY OF AERODYNAMIC SEPARATION DURING FIRST STAGE. PROVIDE COST AND SCHEDULE IMPACTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1.	07/31/86 JSC-GA	

REPORT NO. 2102-1

S D R I   S T A T U S
CATEGORY 1 OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60041 A	1 1		JSC-TE 2-2 S		07/31/86 JSC-GA	
	1 1		KSC-GM 3-1 S	REVIEW CREW ESCAPE ISSUES IDENTIFIED BY THE STS CREW EGRESS AND ESCAPE STUDY RELATIVE TO PRE- AND POST- FLIGHT GROUND OPERATIONS. PROVIDE RECOMMENDATIONS TO THE LEVEL II PRCB. (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1.	07/31/86 JSC-GA	
	1 1		JSC-VA 3-2 S		07/31/86 JSC-GA	
	1 1		JSC-DA 3-3 S		07/31/86 JSC-GA	

PAGE NO. 42
DATE 08/11/86

REPORT NO. 2102-1

S D R I   S T A T U S
CATEGORY 1 OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60041 A	1 1		JSC-VA 4-1 S	IN CONJUNCTION WITH THE ORBITER CONTRACTOR, DEVELOP ROM IMPACTS OF VARIOUS MECHANISMS THAT HAVE BEEN PROPOSED FOR CREW EJECTION FROM THE ORBITER. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1.	07/31/86 JSC-GA	
	1 1		JSC-EA 5-1 S	INITIATE CONCEPT STUDY FOR LONGER RANGE IMPLEMENTATION OF CREW EJECTION CONFIGURATIONS FOR THE SHUTTLE CONSISTING OF A COMBINATION OF EJECTION SEATS AND EJECTABLE PASSENGER COMPARTMENTS. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	07/31/86 JSC-GA	

REPORT NO. 2102-1

SDRI STATUS
CATEGORY 1 OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60041 A	1 1		JSC-EA 6-1 S	CONTINUE ENGINEERING STUDIES RELATED TO ORBITER STRUCTURAL INTEGRITY WITH RESPECT TO DITCHING. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1.	07/31/86 JSC-GA	
	1 1		JSC-DA 7-1 S	INTIATE APPROPRIATE PLANNING AND IMPLEMENTATION TO PROVIDE FOR TRAINING FOR DITCHING. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1.	07/31/86 JSC-GA	
60041 AR1	1 1	CREW ESCAPE CAPABILITY FROM LIFTOFF THROUGH ROLLOUT	JSC-VA 1-1 S	ARRANGE AND ENSURE ADEQUATE PARTICIPATION OF ALL OTHER NASA ELEMENTS WHICH POSSESS KNOWLEDGE AND EXPERTISE IN AERODYNAMICS IN ALL CREW EGRESS AND ESCAPE ACTIVITIES THAT ARE INFLUENCED OR AFFECTED BY AERODYNAMICS. CATEGORY 1	09/08/86 JSC-GA	

PAGE NO. 44
DATE 08/11/86

REPORT NO. 2102-1

S D R I S T A T U S
CATEGORY 1 OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60041 AR1	1 1		JSC-VA 2-1 S	DEVELOP DETAILED RATIONALE TO SUPPORT THE EVIDENCE OF DITCHING IN ABORT SITUATIONS. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1.	09/08/86 JSC-GA	
60042 R1	1 1	RANGE SAFETY SYSTEM CONCERNS	JSC-AM 1-1 S	PROVIDE SPECIFIC RECOMMENDATIONS TO THE NSTS PROGRAM MANAGER AND THE RANGE SAFETY PANEL CONCERNING FUTURE UTILIZATION OF THE RANGE SAFETY DESTRUCT SYSTEMS ON SHUTTLE ELEMENTS. CATEGORY 1.	07/11/86 JSC-AM	

REPORT NO. 2102-1

S D R I S T A T U S
CATEGORY 1 OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60047 R2	1 1	INADVERTENT MODE TRANSITION	JSCGA/OASCB 1-1 S	DEVELOP MANPOWER/SCHEDULE/COST AND OTHER IMPACTS ASSOCIATED WITH THIS CHANGE IN CONJUNCTION WITH AN OVERALL AVIONICS SOFTWARE REVIEW RECOMMENDATIONS REGARDING THIS CHANGE WILL BE DEVELOPED BY THE OASCB. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1.	07/11/86 JSC-AM	
	1 1		JSC-VA 1-2 S		07/11/86 JSC-AM	
60048 R1	1	SPLIT-S RTLS CAPABILITY FOR EARLY LOSS, 2 OR 3 SSME'S	JSC-TA 1-1 S	ANALYZE AND DEFINE ET/SRB/ORB STRUCTURAL CAPABILITY TO WITHSTAND LOADS GENERATED BY SPLIT-S RTLS ABORT WITH 2 OR 3 ENGINES FAILED AND SRB'S THRUSTING. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1	07/11/86 JSC-AM	

REPORT NO. 2102-1

S D R I S T A T U S
CATEGORY 1 OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60048 R1	1		JSC-EA 1-2 S		07/11/86 JSC-AM	
	1		JSC-DA 3-1 S	DEFINE SCOPE OF AERODYNAMICS AND VEHICLE MANEUVERING CONSIDERATIONS REQUIRED TO SUPPORT STRUCTURAL ANALYSIS FOR SPLIT-S RTLS. CATEGORY 1.	07/11/86 JSC-AM	
	1		JSC-VA 4-1 S	IMPLEMENT SOFTWARE CHANGE REQUEST 79643A, 79644B AND 79646C THUS PROVIDING A SPLIT-S RTLS CAPABILITY. CATEGORY 1	07/11/86 JSC-AM	
	1		JSCGA/OASCB 4-2 S		07/11/86 JSC-AM	

REPORT NO. 2102-1

S D R I   S T A T U S
CATEGORY 1 OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60064 R1	1	APU WATER VALVE FAILURE CAUSED BY CORROSION	JSC-TE 1-1 S	SUBMIT AN RCN TO OMRSD, JSC-08171, TO DIRECT PERFORMANCE OF AN INSPECTION, EACH FLIGHT, OF THE APU WATER VALVE, TO CHECK FOR CORROSION. THIS ACTION HAS BEEN DESIGNATED AS CATEGORY 1.	07/11/86 JSC-AE	
60068 R1	1	OME BI-PROPELLANT VALVE LEAKAGE	JSC-TE 1-1 S	SUBMIT RCN TO OMRSD, AS APPROPRIATE, TO PERFORM OME INSPECTION AFTER EVERY FLIGHT TO ENSURE TIMELY IMPLEMENTATION OF ENGINE PROTECTION PROCEDURES. CATEGORY 1.	07/11/86 JSC-AE	

REPORT NO. 2102-1

S D R I S T A T U S
CATEGORY 1 OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60069 R1	1 1	COMBUSTION INSTABILITY OF RCS PRIMARY THRUSTERS	JSC-VA 2-1 S	DEVELOP A PLAN TO RESOLVE RCS THRUSTER INSTABILITY CONCERNS, TO INCLUDE RECOMMENDATIONS ON ADDITIONAL TESTING AND THE FEASIBILITY OF IMPLEMENTING AN INSTABILITY DETECTION OR BURN-THROUGH DETECTION SYSTEM AN INCREMENTAL APPROACH TO TESTING AND/OR ADDING INSTABILITY DETECTION CAPABILITY SHALL BE CONSIDERED, GIVING HIGHEST PRIORITY TO HIGH-USE ENGINES. REPORT RESULTS TO SP PRCB (SDRB)). CATEGORY 1.	07/11/86 JSC-AE	

REPORT NO. 2102-1

SDRI STATUS
CATEGORY 1 OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60069 R1	1 1		JSC-VA 3-1 S	INVESTIGATE AND DEFINE THE SOURCES OF RCS THRUSTER INSTABILITY/ FAILURES. DETERMINE WHETHER THE SOURCES REPRESENT VENDOR UNIQUE PHENOMENA OR AN RCS SYS-TEMATIC FAULT. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1.	07/11/86 JSC-AE	
	1 1		JSC-EA 3-2 S		07/11/86 JSC-AE	
	1 1		JSC-GA/M 3-3 S		07/11/86 JSC-AE	

REPORT NO. 2102-1

S D R I S T A T U S
CATEGORY 1 OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60069 R2	1 1	COMBUSTION INSTABILITY OF RCS PRIMARY THRUSTERS	JSC-VA 1-1 S	IMPLEMENT IN YOUR PROJECT STUDIES/TESTS TO SUPPORT DEVELOPMENT OF A SYSTEM FOR DETECTION OF RCS THRUSTER INSTABILITY OR BURNTHROUGH. ISSUE APPROPRIATE DIRECTION TO YOUR CONTRACTOR. CATEGORY 1.	07/21/86 JSC-AE	
60072 R1	 1	INTERNAL REACTANT LEAKAGE WITHIN FUEL CELLS	JSC-VA 1-1 S	SUBMIT RCN TO UPDATE OMRSD AS APPROPRIATE TO PERFORM N2 DIAGNOSTIC TEST EVERY FLIGHT. CATEGORY 1.	07/11/86 JSC-AE	
60074	1 1	WCS WIRE HARNESS FLAMMABILITY	JSC-EA 1-1 S	REVIEW ALL MATERIALS USAGE AGREEMENT DOCUMENTATION ALLOWING USE OF RAYCHEM WIRING IN THE ORBITER CREW COMPARTMENT REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	04/30/86 JSC-EA	

REPORT NO. 2102-1

SDRI STATUS
CATEGORY 1 OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60074	1 1		JSC-VA 2-1 S	REVIEW ALL APPLICATIONS OF RAYCHEM WIRING IN THE ORBITER CREW COMPARTMENT REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1.	04/30/86 JSC-EA	
	1 1		JSC-VA 3-1 S	PROVIDE IMPLEMENTATION SCHEDULE FOR MODIFICATION AND REPLACEMENT OF THE WCS WIRE HARNESS. INCLUDE EVALUATION OF A) CIRCUIT PROTECTION/ SEPARATION, B) USE OF RAYCHEM WIRING AND C) WIRE HARNESS CONNECTOR STRAIN RELIEF. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	04/30/86 JSC-EA	

REPORT NO. 2102-1

SDRI STATUS
CATEGORY 1 OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60074 R3	1 1	WCS WIRE HARNESS FLAMMABILITY	JSC-VA 1-1 S	PROVIDE MODIFICATION HARDWARE AND ENGINEERING TO ACCOMPLISH INSTALLATION OF A MODIFIED WCS WIRE HARNESS CONTAINING NO RAYCHEM WIRING. SUBMIT TO THE LEVEL II PRCB FOR MODIFICATION IMPLEMENTATION IN OV-102. CATEGORY 1.	09/01/86 JSC-EA	
	1 1		JSC-VA 1-2 S		09/01/86 JSC-EA	
	1 1		JSC-VA 1-3 S		09/01/86 JSC-EA	
60088 R1	1 1	MLG DOOR BOOSTER BUNGEE	JSC-VA 1-1 S	RE-INITIATE TASK TO DETERMINE POSITIVE METHOD OF RIGGING BUNGEE TO ENSURE THAT IT IS PROPERLY SET. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1.	07/11/86 JSC-AE	

REPORT NO. 2102-1

SDRI STATUS
CATEGORY 1 OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60088 R1	1 1		JSC-VA 2-1 S	REVIEW CURRENT DESIGN FOR POTENTIAL IMPROVEMENT INCLUDING DIFFERENT METHODS OF APPLYING DOOR OPENING FORCE AND REDUCTION IN BUNGEE TENSION. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1.	07/11/86 JSC-AE	
60089 R2	1 1	IMPROVED TPS AROUND NOSE CAP	JSC-EA 1-1 S	DETERMINE OPTIONS FOR AN INTERIM TPS MODIFICATION FOR INCORPORATION PRIOR TO FIRST REFLIGHT. INCLUDE ASSOCIATED IMPACTS WITH THESE CONSIDERATIONS. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DEISNG REVIEW BOARD). CATEGORY 1.	09/15/86 JSC-AE	
	1 1		JSC-VA 1-2 S		09/15/86 JSC-AE	

REPORT NO. 2102-1

SDRI STATUS
CATEGORY 1 OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60091 R1	1 1	POSSIBLE CROSS-CONNECTING OF GRND RACK PIC CONNECTIONS	JSC-GA/M 2-1 S	REVIEW AND IDENTIFY ALL NON-KEYED GSE CONNECTORS LISTED IN THE CONTROLLED HAZARDS DOCUMENT AND ASSESS SAFETY RATIONALE FOR ACCEPTANCE AND THE DEGREE OF HAZARD INVOLVED. CATEGORY 1.	07/11/86 JSC-AE	
60099	1 1	ATCS-FLASH EVAPORATOR FREON LEAK	JSC-VA 1-1 S	IMPLEMENT ADDITION OF IMPACT PROTECTION FOR EACH FLASH EVAPORATOR IN YOUR PROJECT AND ISSUE APPROPRIATE DIRECTION TO YOUR CONTRACTOR. CATEGORY 1	07/21/86 JSC-AE	
60099 R1	1 1	ATCS-FLASH EVAPORATOR FREON LEAK	JSC-TE 1-1 S	SUBMIT AN RCN TO INSPECT THE FLASH EVAPORATOR FOR PHYSICAL DAMAGE BEFORE EACH FLIGHT. CATEGORY 1	08/11/86 JSC-AE	

REPORT NO. 2102-1

S D R I   S T A T U S
CATEGORY 1 OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60099 R2	1 1	ATCS-FLASH EVAPORA TOR FREON LEAK	JSC-VA 1-1 S	PROVIDE MODIFICATION HARDWARE AND ENGINEERING TO ACCOMPLISH INSTALLA- TION OF IMPACT PROTEC- TION FOR EACH FLASH EVAPORATOR. SUBMIT TO THE LEVEL II PRCB FOR MODIFICATION IMPLEMENTA- TION IN OV-102. CATEGORY 1.	09/01/86 JSC-AE	
	1 1		JSC-VA 1-2 S		09/01/86 JSC-AE	
	1 1		JSC-VA 1-3 S		09/01/86 JSC-AE	
60105	1 1	POTENTIAL DAMAGE O F SEPARATION SYSTE M PYRO WIRES	JSC-VA 1-1 S	IMPLEMENT IN YOUR PROJECT, MODIFICATION OF PYRO BLAST CONTAINERS FOR THE ORBITER/ET STRUCTURAL AND UMBILICAL SEPARATION SYSTEMS, AND ISSUE APPROPRIATE DIRECTION TO YOUR CONTRACTOR. CATEGORY 1.	07/11/86 JSC-AE	

REPORT NO. 2102-1

S D R I S T A T U S
CATEGORY 1 OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60105 R2	1 1	POTENTIAL DAMAGE OF SEPARATION SYSTEM PYRO WIRES	JSC-VA 1-1 S	PROVIDE MODIFICATION HARDWARE AND ENGINEERING TO ACCOMPLISH MODIFICATION OF THE PYRO BLAST CONTAINERS FOR THE ORBITER/ET STRUCTURAL AND UMBILICAL SEPARATION SYSTEMS. SUBMIT TO THE LEVEL II PRCB FOR MODIFICATION IMPLEMENTATION IN OV-102. CATEGORY 1.	09/01/86 JSC-AE	
	1 1		JSC-VA 1-2 S		09/01/86 JSC-AE	
	1 1		JSC-VA 1-3 S		09/01/86 JSC-AE	

REPORT NO. 2102-1

S D R I   S T A T U S
CATEGORY 1 OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60106	1 1	UMBILICAL SEPARATI ON SYSTEM HARDWARE ASSEMBLY	JSC-VA 1-1 S	PROCEED WITH IMPLEMENTATION OF MODIFICATION FOR VERIFICATION OF UMBILICAL SEPARATION ASSEMBLY INSTALLATION, AND ISSUE APPROPRIATE DIRECTION TO YOUR CONTRACTOR. REPORT IMPLEMENTATION STATUS TO SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1.	07/11/86 JSC-AE	
	1 1		JSC-GA/M 4-1 S	VERIFY ADEQUACY OF MODIFICATION TO PERMIT SPHERICAL WASHERS INSTALLATION VERIFICATION, AND IDENTIFY ANY CONCERNS NOT ADDRESSED BY THE MODIFICATION. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1	07/11/86 JSC-AE	

REPORT NO. 2102-1

SDRI STATUS
CATEGORY 1 OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60106 R1	1 1	UMBILICAL SEPARATION SYSTEM HARDWARE ASSEMBLY	JSC-VA 1-1 S	PROVIDE MODIFICATION HARDWARE AND ENGINEERING TO ACCOMPLISH INSTALLATION VERIFICATION OF THE UMBILICAL SEPARATION ASSEMBLY. SUBMIT TO THE LEVEL II PRCB FOR MODIFICATION IMPLEMENTATION IN OV-102. CATEGORY 1.	09/01/86 JSC-AE	
	1 1		JSC-VA 1-2 S		09/01/86 JSC-AE	
	1 1		JSC-VA 1-3 S		09/01/86 JSC-AE	
60107 R1	2 1	ET AFT UMBILICAL DOOR THERMAL BARRIER	JSC-VA 1-1 S	REEVALUATE ET AFT UMBILICAL DOOR THERMAL BARRIER REPAIR PROCEDURES TO IDENTIFY POSSIBLE IMPROVEMENTS. REPORT RECOMMENDATIONS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1	07/31/86 JSC-AE	

PAGE NO. 59
DATE 08/11/86

REPORT NO. 2102-1

S D R I   S T A T U S
CATEGORY 1 OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60120	1	POTENTIALLY CATAST ROPHIC SSME SHUTDO WN DUE TO DATA/COM	JSC-VA 1-1 S	DETERMINE IF THE IN-WORK S/W CHANGE CAN RESOLVE DATA COMMAND PATH FAIL- URE. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1.	06/20/86 JSC-AE	
60131	1 1	100 PERCENT NDT OF SOLID ROCKET MOTOR SEGMENTS	MSFC-SRB 1-1 S	REPORT RESOLUTION OF THIS ISSUE, REGARDING 100 PERCENT NDT OF SRM SEGMENTS, TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1	12/01/86 JSC-NA	
60132	1 1	SRB AMBIENT TEMPER ATURE LAUNCH COMMI T CRITERIA	MSFC-SRB 1-1 S	REPORT RESOLUTION OF THIS ISSUE, REGARDING SRB AMBIENT TEMPERATURE LCC, TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1.	12/01/86 JSC-NA	

REPORT NO. 2102-1

S D R I S T A T U S
CATEGORY 1 OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60133	1 1	SRB JOINT SEAL TES T PLUG INTEGRITY	MSFC-SRB 1-1 S	REPORT RESOLUTION OF THIS ISSUE, REGARDING SRB JOINT SEAL TEST PLUG INTEGRITY TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1	12/01/86 JSC-NA	
60134	1 1	SRB FILAMENT WOUND CASE FIELD JOINT D ESIGN & CERTIFICAT	MSFC-SRB 1-1 S	REPORT RESOLUTION OF THIS ISSUE, REGARDING SRB FWC FIELD JOINT DE- SIGN/CERTIFICATION, TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN RE- VIEW BOARD). CATEGORY 1	12/01/86 JSC-NA	
60143 R1	1 1	PRESERVATION SRB S EGMENT ROUNDNESS D URING GRND HANDLNG	MSFC-SRB 1-1 S	REPORT RESOLUTION OF THIS ISSUE, REGARDING SRB SEGMENT ROUNDESSS, INCLUDING CR S40062, TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1.	09/04/86 JSC-NA	

REPORT NO. 2102-1

S D R I S T A T U S
CATEGORY 1 OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60144 R1	1	MPS - SSME CRITICALITY VALVES	MSFC-SSME 1-1 S	PROVIDE BASIS OF PRESENT SSME CHECK VALVE CONFIGURATION AND ASSESS IMPACTS OF MAKING THESE CHECK VALVES REDUNDANT. INCLUDE CHARACTERISTICS OF A REDESIGN, ENGINE PERFORMANCE, ACCESSIBILITY, AND PRESSURE DROP CONSIDERATIONS FROM ADDITION OF CHECK VALVES REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1.	07/14/86 JSC-NA	
60146 R1	1	LOSS OF ORB WINDSHLD DUE TO THERMAL STRESS/BIRD IMPACT	JSC-VA 1-1 S	ASSESS IMPACTS FOR CONDUCTING MEANINGFUL TESTS TO DETERMINE THE CAPABILITY OF CURRENT ORBITER WINDOWS TO WITHSTAND BIRD IMPACTS. REPORT RESULTS TO SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1.	07/14/86 JSC-NA	

REPORT NO. 2102-1

S D R I S T A T U S
CATEGORY 1 OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60148	1	SHORTING BTWN ADJ PINS IN BFS FLT CN TRLLR PWR CONNECTR	JSC-NA 2-1 S	PERFORM AN AUDIT OF SELECTED AREAS OF ALL PROGRAM ELEMENTS OF THE NSTS TO DETERMINE THE DEGREE OF COMPLIANCE WITH THE REDUNDANT CIRCUIT SEPARATION CRITERIA SPECIFIED IN JSC-8080. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). THIS ACTION HAS BEEN DESIGNATED CATEGORY 1.	06/12/86 JSC-NA	
60148 R1	1	SHORTING BTWN ADJ PINS IN BFS FLT CN TRLLR PWR CONNECTR	JSC-VA 1-1 S	PROVIDE COMPLETE DEFINITION OF COMPLIANCE W/THE REDUNDANT CIRCUIT SEPARATION CRITERIA OF JSC-8080 FOR ALL NSTS FLIGHT ELEMENTS AND DEVELOP IMPACTS, IF ANY, TO ACHIEVE FULL COMPLIANCE WITH THESE REQUIREMENTS. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1.	07/11/86 JSC-NA	

REPORT NO. 2102-1

S D R I S T A T U S
CATEGORY 1 OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60148 R1	1		JSC-TA 1-2 S		07/11/86 JSC-NA	
60152 R1	1 1	CERTIFICATION OF TAL MODES	JSC-VA 1-1 S	PROVIDE PLAN FOR FLIGHT-BY-FLIGHT AND SUBSEQUENT GENERIC CERTIFICATION OF TAL ABORTS. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1.	07/25/86 JSC-GA	
	1 1		MSFC-ET 1-2 S		07/25/86 JSC-GA	
	1 1		JSC-TA 1-3 S		07/25/86 JSC-GA	

REPORT NO. 2102-1

S D R I S T A T U S
CATEGORY 1 OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60152 R2	1 1	CERTIFICATION OF TAL ABORT MODES	JSC-VA 1-1 S	REVIEW AND ASSESS RESULTS OF ON GOING STUDIES RELATIVE TO OPERATION OF OMS ENGINES IN THE PRESENCE OF SIGNIFICANT Z OR Y AXIS ACCELERATIONS. INCORPORATE RESOLUTION IN CERTIFICATION OF TAL. CATEGORY 1.	08/15/86 JSC-TA	
60153 R1	1 1	CONTINGENCY ABORT	JSC-VA 1-1 S	DETERMINE STATUS OF CERTIFICATION FOR CONTINGENCY ABORTS AND PROVIDE RECOMMENDATIONS FOR APPROPRIATE ACTIONS REQUIRED TO ACCOMPLISH CONTINGENCY ABORT CERTIFICATION.REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).CATEGORY 1	07/25/86 JSC-GA	
	1 1		JSC-TA 1-2 S		07/25/86 JSC-GA	
	1 1		MSFC-ET 1-3 S		07/25/86 JSC-GA	

REPORT NO. 2102-1

S D R I S T A T U S
CATEGORY 1 OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60153 R2	1 1	CONTINGENCY ABORTS	JSC-TE 1-1 S	DEFINE CURRENT CONTRACTOR ACTIVITIES/ RESPONSIBILITIES AND DETERMINE A SPECIFIC WORK PLAN, INCLUDING ASSOCIATED IMPACTS, RELATIVE TO EXPANSION OF THE AERODYNAMIC DATA BASES TO SUPPORT ASSESSMENTS PERTAINING TO CONTINGENCY ABORTS. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1.	09/15/86 JSC-TA	
	1 1		JSC-VA 1-2 S		09/15/86 JSC-TA	

REPORT NO. 2102-1

S D R I S T A T U S
CATEGORY 1 OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60153 R2	1 1		JSC-VA 2-1 S	ENSURE CONTRACTOR PARTICIPATION IN DEFINITION/IMPLEMENTATION OF SES UPGRADE FOR FLIGHT CONTROL ANALYSIS AND REQUIREMENTS DEVELOPMENT PERTAINING TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1.	09/15/86 JSC-TA	
	1 1		JSC-VA 3-1 S	DETERMINE IMPACTS RELATIVE TO PERFORMING FLIGHT CONTROL, THERMAL AND STRUCTURAL ANALYSES PERTAINING TO CONTINGENCY ABORTS. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1.	09/15/86 JSC-TA	
	1 1		JSC-EA 3-2 S		09/15/86 JSC-TA	
	1 1		JSC-TE 3-3 S		09/15/86 JSC-TA	

REPORT NO. 2102-I

S D R I   S T A T U S
CATEGORY 1 OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60154	1 1	CERTIFICATION OF 10.2 CABIN ATMOSPHERE	JSC-VA 1-1 S	REVIEW AND UPDATE PREVIOUSLY ASSESSED AND DEFINED IMPACTS AS REQUIRED TO SUPPORT CERTIFICATION OF 10.2 PSIA CABIN ATMOSPHERE OPERATIONS. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD) CATEGORY 1	07/11/86 JSC-VA	
	1 1		JSC-DA 1-2 S		07/11/86 JSC-VA	
	1 1		JSC-EA 1-3 S		07/11/86 JSC-VA	
	1 1		JSC-CA 1-4 S		07/11/86 JSC-VA	

REPORT NO. 2102-1

S D R I S T A T U S
CATEGORY 1 OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60154	1 1		JSC-VA 2-1 S	ASSESS THE CAPABILITY TO ACCURATELY DETERMINE AND CONTROL PPO2 FOR 10.2 PSI OPERATIONS. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1	07/11/86 JSC-VA	
	1 1		JSC-EA 2-2 S		07/11/86 JSC-VA	
60173	1 1	BOLT CCTV CAMERAS TO X0576 BULKHEAD	JSC-VA 1-1 S	ASSESS IMPACTS OF BOLTING CCTV SUPPORT FITTINGS TO THE X0576 BULKHEAD AND PROVIDE RATIONALE AND IMPACTS IF ANOTHER COURSE OF ACTION IS RECOMMENDED. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1.	07/31/86 KSC-NE	

REPORT NO. 2102-1

S D R I S T A T U S
CATEGORY 1 OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60173	1 1		JSC-VA 2-1 S	REVIEW ALL BONDING APPLICATIONS TO DETER- MINE IF THERE ARE OTHER POTENTIAL AREAS FOR DAMAGE FROM DEBONDED HARDWARE. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1.	07/31/86 KSC-NE	
	1 1		KSC-NE 3-1 S	DEVELOP COMPLETE HISTORY OF HARDWARE DEBONDING INCIDENTS IN THE PRO- GRAM. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1.	07/31/86 KSC-NE	
60175	1 1	LOSS OF SRB FORWAR D ASSEMBLY ABLATOR	JSC-TE 1-1 S	REVIEW POSSIBLE DELETION OF ABLATOR FROM THE SRB. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1.	07/31/86 KSC-NE	

REPORT NO. 2102-1

S D R I S T A T U S
CATEGORY 1 OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60175	1 1		MSFC-SRB 1-2 S		07/31/86 KSC-NE	
	1 1		JSC-TE 2-1 S	REVIEW PREVIOUS SRB ASCENT FILM DATA AVAILABLE. ASSESS POTENTIAL USE OF CAMERAS TO GATHER ADDITIONAL FLIGHT DATA RELATIVE TO ABLATOR PERFORMANCE DURING ASCENT, AND INCLUDE IMPACTS. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1.	07/31/86 KSC-NE	
	1 1		MSFC-SRB 3-1 S	PERFORM ANALYSIS TO IDENTIFY CAUSES AND TIMES OF ABLATOR FAILURES INCLUDING PROBABILITY OF ORBITER DAMAGE. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1.	07/31/86 KSC-NE	

REPORT NO. 2102-1

SDRI STATUS
CATEGORY 1 OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60175	1 1		KSC-NE 3-2 S		07/31/86 KSC-NE	
	1 1		MSFC-SRB 4-1 S	ASSESS POSSIBLE REVISION OF APPLICATION PROCEDURES/TECHNIQUES AND MATERIALS USAGE TO PRECLUDE LOSS OF ABLATOR FROM THE SRB FORWARD ASSEMBLY. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1.	07/31/86 KSC-NE	
60176	1 1	FRAGMENTATION DEBRIS FROM SRB HOLDDOWN POST SEP BOLT	MSFC-SRB 1-1 S	PRESENT PROPOSED REDESIGN, INCLUDING IMPACTS, OF THE HOLDDOWN POST FRAGMENT RETENTION SYSTEM TO ASSURE DEBRIS CONTAINMENT. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1	07/31/86 KSC-NE	

REPORT NO. 2102-1

S D R I S T A T U S
CATEGORY 1 OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60177	1 1	DEBRIS IN THE ET UMBILICAL DOOR AFTER ORB/ET SEP	JSC-VA 1-1 S	REVIEW HISTORY OF DEBRIS FROM ORBITER/ET AFT UMBILICAL AREA AND PROPOSE POTENTIAL DESIGN SOLUTIONS INCLUDING IMPACTS. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1.	07/31/86 KSC-NE	
60178	1 1	FAILURE TO PLUG 2 1/2" SEP BOLT HOLE AFTER ORB/ET SEP	JSC-VA 1-1 S	REVIEW HISTORY OF DEBRIS FROM ORBITER/ET AFT UMBILICAL AREA AND PROPOSE POTENTIAL DESIGN SOLUTIONS INCLUDING IMPACTS. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB. (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1.	07/31/86 KSC-NE	

REPORT NO. 2102-1

SDRI STATUS
CATEGORY 1 OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60183	1 1	SRB HOLDDOWN POST RELEASE REDUNDANCY	JSC-VA 1-1 S	REVIEW PHYSICAL CONFIGURATION OF THE HOLDDOWN POST PYRO WIRING, CONSIDERING SUSCEPTIBILITY TO HANDLING DAMAGE. INCLUDE CONSIDERATIONS OF ADDING PARALLEL WIRING. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1.	07/31/86 KSC-NE	
	1 1		JSC-VA 2-1 S	REVIEW PHYSICAL CONFIGURATIONS OF ALL PYROTECHNIC WIRING TO REAFFIRM PREVIOUS DECISIONS REGARDING ADEQUACY OF DUAL STRING REDUNDANCY OR TO IDENTIFY AREAS WHERE ADDITIONAL REDUNDANCY IS RECOMMENDED. REPORT RESULTS AND IMPACTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1.	07/31/86 KSC-NE	

REPORT NO. 2102-1

S D R I S T A T U S
CATEGORY 1 OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60184	1 1	.DIRECT STOW SWITCH/KU ANTENNA SWITCH	JSC-VA 1-1 S	ASSESS MEANS OF PRECLUDING INADVERTENT ACTIVATION OF KU-BAND DEPLOY AND DIRECT STOW SWITCHES WHICH CAUSES SHORTING OF PHASES B & C OF AC BUSES 2 & 3. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1.	07/31/86 KSC-NE	
60186	1 1	MARGINAL PERFORM RADAR ALTIMETERS @ LOW ALT/MAX USE	JSC-DA 1-1 S	DETERMINE CRITICALITY OF RADAR ALTIMETER INCLUDING CONSIDERATIONS OF PLANNED FLIGHT USAGE. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1	07/31/86 KSC-NE	

REPORT NO. 2102-1

S D R I   S T A T U S
CATEGORY 1 OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60186	1 1		JSC-VA 2-1 S	REVIEW OPTIONS FOR RESOLVING THE RADAR ALTIMETER PROBLEMS, INCLUDING CONSIDERATIONS OF REPLACEMENT WITH IMPROVED ALTIMETERS. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1	07/31/86 KSC-NE	
60193	 1	MPS LO2 AND LH2 FE EDLINE SCREENS	JSC-VA 1-1 S	ASSESS ALTERNATE MPS LO2 AND LH2 FEEDLINE SCREEN DESIGNS AND CONFIGURATIONS TO INCREASE SAFETY MARGINS. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1.	07/31/86 KSC-NE	

REPORT NO. 2102-1

S D R I S T A T U S
CATEGORY 1 OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60195	1	HYDRAULIC COMPONENT CONTAMINATION	JSC-VA 1-1 S	DETERMINE WHICH HYDRAULIC COMPONENTS SHOULD BE REMOVED FROM THE VEHICLE FOR ANALYSIS AND CLEANING DUE TO SUSPECTED CONTAMINATION. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1.	07/31/86 KSC-NE	
	1		KSC-NE 1-2 S		07/31/86 KSC-NE	
	1 1		JSC-VA 3-1 S	SUBMIT APPROPRIATE RCN TO PERFORM DETAILED CONTROL TESTS, EXCLUDING THE FREQUENCY RESPONSE TEST, ON ALL HYDRAULIC COMPONENTS PRIOR TO EACH FLIGHT. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1.	07/31/86 KSC-NE	

REPORT NO. 2102-1

SDRI STATUS
CATEGORY 1 OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60199	1 1	ELECTRO CHEMICAL CELLS REDESIGN	KSC-GM 1-1 S	IMPLEMENT IN YOUR PROJECT DEVELOPMENT OF REDESIGN OF THE HYPERGOLIC FUEL VAPOR DETECTION SYSTEM ELECTROCHEMICAL CELLS. CATEGORY 1.	08/14/86 KSC-GM	
60200	1 1	PORTABLE HYPERGOLI C FUEL VAPOR DETEC TOR SYSTEM UPGRADE	KSC-GM 1-1 S	IMPLEMENT IN YOUR PROJECT PROCUREMENT OF THE NEW INTERSCAN 4180 SERIES HYPERGOLIC LEAK DETECTOR.CATEGORY 1	02/14/87 KSC-GM	
60201	1 1	O2 ANALYZER SYSTEM ELIM INACCURACIES, INSTALL PCR O2	KSC-GM 1-1 S	COMPLETE DESIGN/INSTALL-ATION/DOCUMENTATION AND CHECKOUT OF THE ADDITIONAL O2 DEFICIENCY MONITORING SYSTEMS FOR PAD A AND B,MLP 1, 2, 3, OPF AND THE VAB. CATEGORY 1.	08/14/87 KSC-GM	

REPORT NO. 2102-1

SDRI STATUS
CATEGORY 1 OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60202	1 1	HDGS BACKUP	KSC-GM 1-1 S	REPLACE THE CURRENTLY INSTALLED FLOW SENSORS IN THE BACKUP HGDS WITH MASS FLOWMETERS. CATEGORY 1.	08/14/87 KSC-GM	
60204	1 1	HAZARDOUS GAS DETE CTION SYS - ELIMIN ATE VALVE FAULT	KSC-GM 1-1 S	SUBMIT AND IMPLEMENT APPROPRIATE SOFTWARE AND FIRMWARE CHANGE REQUESTS TO ALLOW TRANSMISSION OF DATA WHEN THE HAZARDOUS GAS DETECTION SYSTEM VALVE POSITION FAILURES OCCUR. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).CATEGORY 1	02/14/87 KSC-GM	
60206	1 1	PIC SYSTEM - KEYED CONNECTORS AND SEP ERATE CABLING	KSC-GM 1-1 S	PROVIDE PHYSICALLY SEPARATE ROUTING OF THE PRIMARY AND REDUNDANT SRB HOLDDOWN POST PIC CIRCUITRY. CATEGORY 1	08/14/87 KSC-GM	
	1 1		USAF-VLS 1-2 S		08/14/87 KSC-GM	

REPORT NO. 2102-1

S D R I S T A T U S
CATEGORY 1 OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60206	1 1		KSC-GM 2-1 S	PROVIDE KEYED CONNECTORS FOR THE PIC HOOK UP CABLES TO PRECLUDE MIS-CONNECTION AT THE LAUNCH PADS. CATEGORY 1	08/14/87 KSC-GM	
	1 1		USAF-VLS 2-2 S		08/14/87 KSC-GM	
	1 1		KSC-GM 3-1 S	REVIEW PHYSICAL CONFIG-URATION OF THE HOLD DOWN POST PYRO WIRING, CONSIDERING SUSCEPTI-BILITY TO HANDLING DAMAGE. INCLUDE CON-SIDERATIONS OF ADDING PARALLEL WIRING. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1.	08/14/87 KSC-GM	

REPORT NO. 2102-1

S D R I S T A T U S
CATEGORY 1 OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60208	1 1	METEROLOGICAL SYSTEM UPGRADE	KSC-GM 1-1 S	IMPLEMENT IN YOUR PROJECT RE-ROUTING AND SHIELDING OF METEROLOGICAL CABLES TO AVIOD INTERFERENCE WITH POWER CABLES AND ADDITION OF LINE DRIVERS TO INCREASE SIGNAL STRENGTH. CATEGORY 1	04/14/87 KSC-GM	
60214	1 1	PAD WATER SYSTEMS-FREEZE-PROOF	KSC-GM 1-1 S	IMPLEMENT IN YOUR PROJECT ADDITION OF INSULATION AND/OR HEAT OF ALL WATER SUPPLY AND TRAPPED DRAIN LINES TO PREVENT FREEZING ON THE LAUNCH PADS. CATEGORY 1	08/06/86 KSC-GM	
60216	1 1	MATE/DEMATE DEVICE SCHEDULE	KSC-GM 1-1 S	PERFORM STRESS ANALYSIS OF THE MATE/DEMATE STRUCTURE AND ORBITER HOISTING SYSTEM FOR POTENTIAL HEAVIER ORBITER LOADS. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1.	02/14/87 KSC-GM	

REPORT NO. 2102-1

S D R I STATUS
CATEGORY 1 OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60218	1 1	H2 VENT FLARE STACK - ELIMINATE HAZARD	KSC-GM 1-1 S	IMPLEMENT IN YOUR PROJECT MODIFICATIONS TO ELIMINATE THE HAZARD ASSOCIATED WITH THE LH2 VENT SYSTEM FLARESTACKS CHIMNEY EFFECTS. CATEGORY 1.	02/14/86 KSC-GM	
60219	1 1	MPS LO2/LH2 - INSTALL DEBRIS TRAP	KSC-GM 1-1 S	DEVELOP AND CERTIFY, INCLUDING TESTING AT MPTA, A DEBRIS TRAP AT THE FLIGHT/ GROUND INTERFACE OF THE MPS LOX AND LH2 FILL AND DRAIN LINES. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1	08/14/87 KSC-GM	
	1 1		MSFC-SA01 1-2 S		08/14/87 KSC-GM	

REPORT NO. 2102-1

SDRI STATUS
CATEGORY 1 OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60219	1 1		KSC-GM 2-1 S	DEVELOP AND CERTIFY AN MPS LO2 AND LH2 FILL AND DRAIN LEAK FREE JOINT AT THE FLIGHT/GROUND INTERFACE, IN CONJUNCTION WITH THE DEVELOPMENT OF THE DEBRIS TRAP. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1.	08/14/87 KSC-GM	
60221	1 1	PAYLOAD CHANGEOUT ROOM - ECS UPGRADE	KSC-GM 2-1 S	IMPLEMENT IN YOUR MODIFICATION OF PAYLOAD CHANGEOUT ROOMS TO PROVIDE IMPROVED CONTROL OF ENVIRONMENTAL CONDITIONS FOR PAYLOADS. CATEGORY 1.	08/14/87 KSC-GM	

REPORT NO. 2102-1

S D R I S T A T U S
CATEGORY 1 OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60221	1 1		USAF-VLS 3-1 S	ASSESS ADEQUACY OF VLS PAYLOAD HANDLING FACILITIES FOR ALL EXPECTED CONDITIONS. PROVIDE SPECIFIC IMPLEMENTATION PLAN IF MODIFICATIONS ARE WARRANTED. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1.	08/14/87 KSC-GM	
60222	1 1	EXTENDABLE PLANK DRIVE SYSTEM	KSC-GM 1-1 S	PROCEED WITH DEVELOPMENT OF PCR PLATFORM PLANK PROTOTYPE AND TESTING. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1	02/14/87 KSC-GM	
60225	1 1	LRU PLATFORM - PIN EXTENDABLE PLATFORMS	KSC-GM 1-1 S	IMPLEMENT IN YOUR PROJECT MODIFICATION TO INCORPORATE AN ACCESSIBLE PLATFORM LOCKING SYSTEM IN EXISTING LRU SLIDING PLATFORMS. CATEGORY 1.	06/01/87 KSC-GM	

REPORT NO. 2102-1

S D R I S T A T U S
CATEGORY 1 OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60225	1 1		KSC-GM 2-1 S	IMPLEMENT STUDY AND DESIGN/FABRICATE/TEST PROTOTYPE TO RESOLVE PROBLEMS WITH PAD B DE-SIGN (RECTANGULAR TUBE HOIST CONCEPT). PROVIDE SPECIFIC IMPLEMENTATION PLAN. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1	06/01/87 KSC-GM	
60226	1 1	MAN-RATED ET ACCES S PLATFORMS	KSC-GM 1-1 S	IMPLEMENT IN YOUR PROJECT REDESIGN OF THE ET PLATFORM TO PROVIDE FULL MAN-RATED CAPABILITY. CATEGORY 1	02/14/87 KSC-GM	

REPORT NO. 2102-1

S D R I S T A T U S
CATEGORY 1 OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60227	1 1	ET CHECKOUT CELL-BEEF UP RESTRAINTS	KSC-GM 1-1 S	IMPLEMENT IN YOUR PROJECT REDESIGN INCLUDING STRESS ANAL-YSIS, FABRICATION, AND INSTALLATION OF VAB ET CHECKOUT CELL UPPER RESTRAINT BRACKETS AND ASSOCIATED STRUCTURAL MODIFICATIONS TO PROVIDE A GREATER MARGIN OF SAFETY. CATEGORY 1	02/14/87 KSC-GM	
60230	1 1	RSS DRIVE TRUCKS - CHANGE BEARING	KSC-GM 1-1 S	IMPLEMENT IN YOUR PROJECT CHANGEOUT OF THE RSS DRIVE TRUCK SPHERICAL BEARINGS AND PROVIDE FOR ADEQUATE LUBRICATION. CATEGORY 1	12/14/86 KSC-GM	
60232	1 1	RSS-DEVELOP WEIGHT -VS-CLEARANCE MATRIX & PARKING PLAN	JSC-TE 1-1 S	DEVELOP PAYLOAD WEIGHT VERSUS ORBITER DEFLEC-TION MATRIX FROM STS MODEL. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVEIW BOARD).CATEGORY 1	03/14/87 KSC-GM	

64-548 O—86——14

REPORT NO. 2102-1

S D R I S T A T U S
CATEGORY 1 OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60232	1 1		KSC-GM 2-1 S	DEVELOP ORBITER DEFLECTION TO RSS CLEARANCES AND RSS PARKING PLAN BASED ON THE RESULTS OF THE DEFLECTION MATRIX REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVEIW BOARD). CATEGORY 1	03/14/87 KSC-GM	
60233	1 1	LAUNCH COMPLEX - HARDEN TO PRECLUDE DEBRIS	KSC-GM 1-1 S	IMPLEMENT IN YOUR PROJECT REPAIRS/MODIFICATIONS OF LC-39B AND MLP-2 AS REQUIRED TO REPAIR LAUNCH INDUCED DAMAGE AND PREVENT RECURRENCE. CATEGORY 1	04/14/87 KSC-GM	
60234	1 1	ENVIRONMENTAL EFFECTS ON PAD/MLP SYSTEMS	KSC-GM 1-1 S	STUDY ENVIRONMENTAL EFFECTS ON MLP/PAD LAUNCH CRITICAL SYSTEMS AND COMPONENTS. REPORT RESULTS TO THE LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).CATEGORY 1	02/14/88 KSC-GM	

REPORT NO. 2102-1

S D R I   S T A T U S
CATEGORY 1 OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60235	1 1	GH2 T-O DISCONNECT CENTERING DEVICE	KSC-GM 1-1 S	ASSESS IMPACTS AND IMPLEMENT IN YOUR PRO- JECT MODIFICATION OF PRSD DISCONNECT CENTER- ING DEVICE TO PROVIDE POSITIVE RETENTION. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1.	02/14/87 KSC-GM	
	1 1		KSC-GM 2-1 S	SUBMIT PIRN TO APPROPRIATE ICD TO REFLECT MODIFICATION OF PRSD DISCONNECT CENTERING DEVICE TO PROVIDE POSITIVE RETENTION. CATEGORY 1	02/14/87 KSC-GM	
60236	1 1	HOLD-DOWN POST RED ESIGN KICKER SPRIN GS	KSC-GM 1-1 S	IMPLEMENT IN YOUR PROJECT REDESIGN OF THE BLAST SHIELD TO ENSURE SUFFICIENT CLOSING TORQUE AT LIFT-OFF AND ELIMINATE POTENTIAL DEBRIS SOURCES. CATEGORY 1	12/15/86 KSC-GM	

REPORT NO. 2102-1

S D R I S T A T U S
CATEGORY 1 OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60237	1 1	TAIL SERVICE MAST-ELIMINATE GALLING	KSC-GM 1-1 S	IMPLEMENT IN YOUR PROJECT MODIFICATION OF THE TAIL SERVICE MAST LINKS. CATEGORY 1	02/14/87 KSC-GM	
60239	1 1	POTENTIAL SHORTING OF THE AC BUSSES	JSC-VA 1-1 S	IMPLEMENT REPLACEMENT OF THE NINE 3 AMP FUSES WITH NINE 1/2 AMP FUSES IN YOUR PROJECT AND ISSUE APPROPRIATE DIREC-TION TO YOUR CONTRACTOR. SUBMIT COST IMPACTS ASSOCIATED WITH THIS IMPLEMENTATION TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1	08/15/86 JSC-VA	
	1 1		JSC-DA 2-1 S	PROVIDE RECOMMENDATIONS REGARDING METER REQUIRE-MENTS/PROCEDURES AND ASSESS OPTIONS FOR DELETION, REPLACEMENT OR RETENTION OF THESE METERS. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).CATEGORY 1	08/15/86 JSC-VA	

REPORT NO. 2102-1

S D R I   S T A T U S
CATEGORY 1 OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60239	1 1		JSC-CA 2-2 S		08/15/86 JSC-VA	
60239 R1	1 1	POTENTIAL SHOOTING OF THE AC BUSSES	KSC-GM 1-1 S	IMPLEMENT IN YOUR PROJECT REPLACEMENT OF THE NINE 3 AMP FUSES WITH NINE 1/2 AMP FUSES FOR OV-102. CATEGORY 1	08/08/86 JSC-VA	
	1 1		JSC-GM13 2-1 S	UPDATE THE BARS MKKP FILE TO REFLECT THAT MCR 11953 IS THE RESOLUTION FOR REPLACEMENT OF THE NINE 3 AMP FUSES WITH NINE 1/2 AMP FUSES FOR OV-102. CATEGORY 1	08/08/86 JSC-VA	
60240	1 1	FUEL CELL #3 RETUR N LOSS	JSC-VA 1-1 S	PROCEED WITH ENGINEERING AND DEVELOPMENT REQUIRED FOR DELETION OF THE MOTOR SWITCH FUNCTION AND PROVIDE A SPECIFIC IMPLEMENTATION PLAN. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1.	08/15/86 JSC-VA	

REPORT NO. 2102-1

SDRI STATUS
CATEGORY 1 OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60240	1 1		JSC-TA 2-1 S	EXAMINE OPTION,CONSIDERING ALL KNOWN CUSTOMER REQUIREMENTS,FOR LEAVING MOTOR SWITCH IN PLACE DEACTIVATED (RETAINING REACTIVATION CAPABILITY) VS OPTION FOR REMOVING MOTOR (REPLACING LATER IF REQUIRED).REPORT RESULTS TO SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).CATEGORY 1	08/15/86 JSC-VA	
	1 1		JSC-TA 3-1 S	ASSESS PROBABILITY OF CATASTROPHIC FAILURE OF FUEL CELL 3 BASED ON ANALYSIS OF SHUTTLE/ PAYLOAD FLIGHT DATA, REGARDING UNDESIRED VOLTAGE POTENTIAL WITH GROUNDING SYSTEM IN ITS CURRENTLY DEFINED CONFIGURATION. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1.	08/15/86 JSC-VA	

REPORT NO. 2102-1

S D R I S T A T U S
CATEGORY 1 OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60241	1 1	ASCENT POWER FAULT TOLERANCE	JSC-VA 1-1 S	RE-EVALUATE AND UPGRADE PREVIOUS STUDIES RELATIVE TO ASCENT/ENTRY POWER FAULT TOLERANCE. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1.	08/15/86 JSC-VA	
	1 1		JSC-DA 1-2 S		08/15/86 JSC-VA	
	1 1		JSC-TE 1-3 S		08/15/86 JSC-VA	
	1 1		MSFC-SRB 1-4 S		08/15/86 JSC-VA	
	1 1		JSC-CA 1-5 S		08/15/86 JSC-VA	

REPORT NO. 2102-1

SDRI STATUS
CATEGORY 1 OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60252	1 1	RCS PROPELLANT TANK - JET FIRING CONSTRAINT	JSC-VA 1-1 S	REVIEW RCS JET FIRING CONSTRAINTS. RECOMMEND APPROPRIATE ACTION REGARDING CERTIFICATION OF THE AFT RCS TANKS TO ALLOW 6 JETS/TANK TO FIRE FOR LIMITED DURATIONS TO ACCOMMODATE RTLS AND TAL PROPELLANT DUMPS. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1.	08/06/86 JSC-AM	
60255	1	LOSS OF 2 APU'S DURING ASCENT	JSC-VA 1-1 S	PERFORM COMPREHENSIVE STUDY OF FLIGHT CONTROL ISSUES RELATIVE TO THE LOSS OF 2 APU'S DURING POWERED FLIGHT IN CONJUNCTION WITH ACTION ITEM (1-1) OF PRCBD S60031R2. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1.	09/15/86 JSC-DA	

REPORT NO. 2102-1

S D R I S T A T U S
CATEGORY 1 OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60256	 1	FAILURE IN SINGLE IMU ACCEL 10 VOLT REGLTR CAUSE SCALE	JSC-VA 1-1 S	CONDUCT A DETAILED STUDY REGARDING SINGLE FAILURE POINT POTENTIAL WITHIN THE IMU ACCELEROMETER 10 VOLT REGULATOR. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1.	09/15/86 JSC-AM	
60257	1 1	SSME HYDRAULIC SYSTEM QUICK DISCONNECT IMPROVEMENT	MSFC-SSME 1-1 S	ASSESS CRITICALITY OF SSME HYDRAULIC QUICK DISCONNECT FAILURE, INCLUDING FAILURE DETECTION CAPABILITY, AND EFFECTS OF THIS FAILURE. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1.	09/15/86 JSC-AM	

REPORT NO. 2102-1

SDRI STATUS
CATEGORY 1 OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60257	1 1		JSC-VA 2-1 S	DETERMINE OPTIONS, AND ASSOCIATED IMPACTS, FOR FURTHER PROTECTION FROM THE SSME HYDRAULIC SYS- TEM QUICK DISCONNECT FAILURES IN ALL ORBITER APPLICATIONS, INCLUDE CONSIDERATIONS FOR DETECTION AND RESOLUTION OF THESE FAILURES. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1.	09/15/86 JSC-AM	

PAGE NO. 1
DATE 08/11/86

REPORT NO. 2102-2

S D R I S T A T U S
CATEGORY 2 OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60002 R5	 2	GO2 FLOW CONTROL VALVE PARTICLE IMPACT EFFECTS	JSC-VA 1-1 S	REVIEW CERTIFICATION OF SINGLE SEAL FLOW CONTROL VALVE INCLUDING CONSIDERATIONS OF MATERIALS APPLICATIONS. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 2.	07/31/86 KSC-NE	
60016 R3	1 2	RCS REGULATOR CONTAMINATION	JSC-VA 5-1 S	UPON DEFINITION OF CONTAMINATION SOURCE, REDESIGN THE RCS REGULATOR SYSTEM, IF REQUIRED, TO PRECLUDE FAILURES CAUSED BY CONTAMINATION. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 2.	07/11/86 JSC-DA	

REPORT NO. 2102-2

S D R I S T A T U S
CATEGORY 2 OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60023 R1	2	INSTRUMENT PANEL REACH & VISIBILITY LIMITATIONS	JSC-VA 1-1 S	PROCESS SOFTWARE CHANGE REQUEST 79702C IN OVER-ALL SOFTWARE REVIEW. CONSIDER THIS CHANGE FOR EFFECTIVITY IN ASCENT, ON-ORBIT, AND ENTRY MODES. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 2.	07/11/86 JSC-DA	
60029 R2	2	APU ISOLATION VALVE CONCERNS	JSC-VA 2-1 S	DEVELOP AN OVERALL PLAN INCLUDING SCHEDULE, FOR REDESIGN OF THE ISOLA-TION VALVE TO REDUCE PO-TENTIAL OF HYDRAZINE IG-NITION. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN RE-VIEW BOARD). CATEGORY 2	07/07/86 JSC-AM	
	2		JSC-DA 2-2 S		07/07/86 JSC-AM	
	2		JSC-EA 2-3 S		07/07/86 JSC-AM	

REPORT NO. 2102-2

S D R I S T A T U S
CATEGORY 2 OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60035 R1	2	LANDING/DECELERATION SYSTEM CAPABILITY	JSC-VA 8-1 S	DEVELOP A PROPOSAL, INCLUDING IMPACTS, FOR FO/FS NOSEWHEEL STEERING UPGRADE IN ALL AREAS EXCEPT HYDRAULIC. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 2.	06/12/86 JSC-AM	
	2		JSC-VA 9-1 S	DEVELOP A PROPOSAL, INCLUDING IMPACTS, FOR IMPLEMENTING FO/FS NOSEWHEEL STEERING WITH A REDUNDANT ACTUATOR SYSTEM. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).CATEGORY 2	06/12/86 JSC-AM	
60035 R3	2	LANDING/DECELERATION SYSTEM CAPABILITY	JSC-VA 2-1 S	CONDUCT TEST TO DETERMINE CROSSWIND CAPABILITY OF CURRENT TIRE DESIGN. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 2	07/11/86 JSC-AM	

REPORT NO. 2102-2

S D R I S T A T U S
CATEGORY 2 OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60035 R3	2		JSC-VA 3-1 S	FURTHER ASSESS TIRE IMPROVEMENTS THAT COULD LEAD TO ADDITIONAL CROSSWIND CAPABILITY. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).CATEGORY 2.	07/11/86 JSC-AM	
60035 R5	2	LANDING/DECELERATI ON SYSTEM CAPABILI TY	JSC-VA 2-1 S	ASSESS POTENTIAL IM- PROVEMENTS RESULTING FROM LANDING GEAR CON- TINGENCY SKID CAPABILI- TIES AND REASONABLY IM- PLEMENTABLE NOSEWHEEL STRUT EXTENSION. ALSO, IDENTIFY MEASURES RE- QUIRED TO GET ADDITIONAL UNLOADING PERFORMANCE FROM NLG STRUT EXTENSION REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).CATEGORY 2	11/15/86 JSC-AM	

REPORT NO. 2102-2

S D R I S T A T U S
CATEGORY 2 OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60042 R2	1 2	RANGE SAFETY SYSTE M CONCERNS	MSFC-SRB 1-1 S	RE-EVALUATE THE SRB RSS DESIGN/LOCATION TO ASSURE THAT SAFETY AND OPERATIONAL CONSIDERA- TIONS ARE BALANCED. THE EVALUATION SHOULD BE BASED ON REMOVAL OF THE ET RSS SUCH THAT ANY RSS ACTIVATION ON THE SRB'S WILL ALSO CAUSE DISPER- SAL OF THE ET PROPELL- ANTS, AND ALSO FOR THE CASE THAT LEAVES THE EXISTING ET RSS ON THE VEHICLE. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN RE- VIEW BOARD). CATEGORY 2.	08/01/86 JSC-DA	

REPORT NO. 2102-2

S D R I S T A T U S
CATEGORY 2 OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60045 R1	2	SPACELAB INSTRUMENT POINTING SYSTEM LATCH	JSC-TA 1-1 S	REVIEW RECOMMENDATION TO USE ORBITER PAYLOAD LATCHES IN LIEU OF PAYLOAD CLAMP UNITS FOR ALL IPS P/L CONFIGURATIONS AND PROPOSE IMPLEMENTATION PLAN. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 2.	05/27/86 JSC-AM	
	2		MSFC-NA01 1-2 S		05/27/86 JSC-AM	
	2		JSC-TA 2-1 S	REVIEW PROCUREMENT OPTIONS AND MAKE SPECIFIC RECOMMENDATION. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 2.	05/27/86 JSC-AM	

REPORT NO. 2102-2

S D R I S T A T U S
CATEGORY 2 OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60046 R1	2 2	PITCH RHC SUMMING AND BENDING FILTER PLACEMENT	JSCGA/OASCB 1-1 S	DEVELOP MANPOWER/SCHE-DULE/COST AND OTHER IMPACTS ASSOCIATED WITH THIS CHANGE IN CONJUNC-TION WITH AN OVERALL AVIONICS SOFTWARE REVIEW RECOMMENDATIONS REGARD-ING THIS CHANGE WILL BE DEVELOPED BY THE OASCB. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 2.	06/20/86 JSC-AM	
	2 2		JSC-VA 1-2 S		06/20/86 JSC-AM	

REPORT NO. 2102-2

S D R I   S T A T U S
CATEGORY 2 OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60048 R1	 2	SPLIT-S RTLS CAPAB ILITY FOR EARLY LO SS, 2 OR 3 SSME'S	JSC-VA 2-1 S	ASSESS IMPACTS EXPANDING AND UPGRADING THE AERO DATA BASE IN THE HIGH ALPHA/LOW MACH REGIONS TO SUPPORT EFFORTS DEFINING THE INTEGRATED ELEMENTS STRUCTURAL CAPABILITY. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 2	07/11/86 JSC-AM	
60049 R1	2 2	RMS AUTO SAFING CH ECK	KSC-SE 1-1 S	ASSESS THE IMPACTS AND PROVIDE RECOMMENDATIONS TO RESOLVE THE RMS AUTO SAFING CIRCUIT ISSUE BEFORE THE NEXT RMS FLIGHT. ENSURE THAT RE-COMMENDATIONS ARE IN-CLUDED IN THE OVERALL KSC FMEA/CIL REVIEW. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 2	07/25/86 JSC-DA	

REPORT NO. 2102-2

SDRI STATUS
CATEGORY 2 OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60049 R1	2 2		JSC-VA 1-2 S		07/25/86 JSC-DA	
60050 R1	2 2	RMS HAND CONTROLLER BIAS	KSC-NE 1-1 S	ASSESS THE IMPACTS AND PROVIDE RECOMMENDATIONS TO RESOLVE THE RMS HAND CONTROLLER BIAS FAILURES BEFORE THE NEXT RMS FLIGHT. ENSURE THAT RE-COMMENDATIONS ARE IN-CLUDED IN THE KSC FMEA/CIL REVIEW. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 2.	07/25/86 JSC-DA	
	2 2		JSC-VA 1-2 S		07/25/86 JSC-DA	

REPORT NO. 2102-2

SDRI STATUS
CATEGORY 2 OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60051 R1	2 2	RMS SINGLE/DIRECT DRIVE +/- SWITCH C ONTACT SHORT	KSC-NE 1-1 S	ASSESS THE IMPACTS AND PROVIDE RECOMMENDATIONS TO RESOLVE THE RMS DIRECT DRIVE -/+ SWITCH ISSUE BEFORE THE NEXT RMS FLIGHT. ENSURE THAT RECOMMENDATIONS ARE INCLUDED IN THE OVERALL KSC FMEA/CIL REVIEW. REPORT INTERIM STATUS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 2.	07/25/86 JSC-DA	
	2 2		JSC-VA 1-2 S		07/25/86 JSC-DA	
60086 R2	1 2	MLG DOOR BOOSTER B UNGEE	JSC-VA 1-1 S	REVERIFY THE CRITICALITY OF THE MAIN LANDING GEAR DOOR BOOSTER BUNGEE. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 2.	07/31/86 KSC-NE	

REPORT NO. 2102-2

S D R I S T A T U S
CATEGORY 2 OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60107 R1	2 2	ET AFT UMBILICAL D OOR THERMAL BARRIE R	JSC-VA 2-1 S	DEVELOP ALTERNATE CONFI- GURATION FOR RETENTION OF ET AFT UMBILICAL DOOR THERMAL BARRIER WHICH MINIMIZES PROBABLITY OF LAUNCH DAMAGE. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 2.	07/31/86 JSC-AE	
60108	2 2	AERO WING LOAD LIM ITS ON OV-102	JSC-VA 1-1 S	ASSESS THE COMPARATIVE IMPACTS (LONG-TERM PROGRAM VERSUS IMMEDIATE COMMITMENT OF RESOURCES OF 1191 SPAR MODIFICA- TIONS IN OV-102. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 2.	07/11/86 JSC-AE	

REPORT NO. 2102-2

S D R I S T A T U S
CATEGORY 2 OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60113	2 2	ORBITER THERMAL WI NDOW UPGRADE	JSC-VA 1-1 S	IMPLEMENT REPLACEMENT OF THE ORBITER WINDOWS (SIDE AND MIDDLE) WITH THICKER GLASS AND ISSUE APPROPRIATE DIRECTION TO YOUR CONTRACTOR. CATEGORY 2.	07/11/86 JSC-AE	
60113 R1	2 2	ORBITER THERMAL WI NDOW UPGRADE	JSC-VA 1-1 S	PROVIDE MODIFICATION HARDWARE AND ENGINEERING TO ACCOMPLISH REPLACE- MENT OF THE ORBITER SIDE AND MIDDLE WINDOWS WITH THICKER GLASS. SUBMIT TO THE LEVEL II PRCB FOR MODIFICATION IMPLEMENTA- TION IN OV-102. CATEGORY 2.	09/01/86 JSC-AE	
	2 2		JSC-VA 1-2 S		09/01/86 JSC-AE	
	2 2		JSC-VA 1-3 S		09/01/86 JSC-AE	

REPORT NO. 2102-2

S D R I S T A T U S
CATEGORY 2 OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60114	2 2	VERIFICATION OF CE RTIFICATION DATA B ASE FROM OFT FLTS	JSC-VA 1-1 S	COMPLETE VERIFICATION OF CERTIFICATION DATA BASE FROM OFT FLIGHTS. PROVIDE SCHEDULE FOR COMPLETION OF VERIFICATION TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 2.	06/20/86 JSC-AE	
60116	 2	CONVERSION OF OV-1 02 DFI TO OI MEASU REMENTS	JSC-VA 1-1 S	INCLUDE THE REMAINDER OF DFI-TO-OI CONVERSION FOR OV-102 (MCR 7655), IN PLANNING CONSISTENT WITH OTHER PROGRAM PRIORITIES. REPORT SCHEDULING CONSIDERATIONS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 2.	07/11/86 JSC-AE	

REPORT NO. 2102-2

SDRI STATUS
CATEGORY 2 OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60117 R1	2 2	TPS BOND INTEGRITY ON OV-102	JSC-VA 1-1 S	INCLUDE IN YOUR PLANNING CONSISTENT WITH OTHER PROGRAM PRIORITIES, THE REPLACEMENT OF THE SUS-PECT OV-102 TILES (THOSE BONDED TO ADJACENT TILES) WITH OV-103 DESIGN TILES. REPORT SCHEDULING CONSIDERA-TIONS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 2.	07/11/86 JSC-AE	
60120	2	POTENTIALLY CATAST ROPHIC SSME SHUTDO WN DUE TO DATA/COM	JSC-VA 2-1 S	IN CONJUNCTION WITH THE MAIN ENGINE SHUTDOWN CONCERNS MODE TEAM, DE-VELOP REASONABLE SYSTEM ARCHITECTURE CHANGE TO PROTECT AGAINST DUAL FAILURE COMBINATIONS (GPC AND AC POWER BUS). REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 2.	06/20/86 JSC-AE	

REPORT NO. 2102-2

S D R I S T A T U S
CATEGORY 2 OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60121	2 2	POTENTIAL LOSS OF REDUNDANCY DUE TO NON-UNIVERSAL I/O	JSC-VA 1-1 S	EVALUATE HARDWARE AND SOFTWARE RESOLUTION OF THE NON-UNIVERSAL I/O ERROR ISSUE. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 2	07/11/86 JSC-AE	
60148	 2	SHORTING BTWN ADJ PINS IN BFS FLT CN TRLLR PWR CONNECTR	JSC-VA 3-1 S	ASSESS SCHEDULE/COST IMPACTS FOR REPLACEMENT OF CONNECTORS IDENTIFIED AS NOT MEETING THE REDUNDANT CIRCUIT SEPAR-ATION CRITERIA SPECIFIED IN JSC-8080. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). THIS ACTION HAS BEEN DESIGNATED CATEGORY 2.	07/14/86 JSC-NA	

REPORT NO. 2102-2

SDRI STATUS
CATEGORY 2 OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60150	2 2	NON-VALID/OBSOLETE COAS CALIBRATION I-LOADS	JSC-DA 1-1 S	INCLUDE THE ISSUE OF USING COAS CALIBRATION DATA WHICH MAY BE NON-VALID OR OBSOLETE FOR I-LOADS IN THE ON-ORBIT FLIGHT TECHNIQUES PANEL ACTIVITIES FOR RESOLUTION. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 2	07/11/86 JSC-EA	
60151	2 2	NO DATA SUPPORT FOR COAS CALIB I-LOADS RESTORATION	JSC-DA 1-1 S	INCLUDE THE ISSUE OF NO PROVISION OF ONBOARD DATA AND PROCEDURES FOR RESTORATION OF COAS CALIBRATION I-LOADS IN THE ON-ORBIT FLIGHT TECHNIQUES PANEL ACTIVITIES. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 2	07/11/86 JSC-EA	

REPORT NO. 2102-2

S D R I S T A T U S
CATEGORY 2 OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60155	2 2	GALLEY WIRE HARNES S FLAMMABILITY	JSC-VA 1-1 S	IMPLEMENT IN YOUR PROJECT THE WRAPPING OF EACH GALLEY UNIT WIRE HARNESS WITH BETA-CLOTH OR AN EQUIVALENT MATERIAL FOR ADDED FLAMMABILITY PROTECTION. PROVIDE APPROPRIATE DIRECTION TO YOUR CONTRACTOR. CATEGORY 2.	07/11/86 JSC-AE	
60155 R1	2 2	GALLEY WIRE HARNES S FLAMMABILITY	JSC-VA 1-1 S	PROVIDE MODIFICATION HARDWARE AND ENGINEERING TO WRAP EACH GALLEY UNIT WIRE HARNESS WITH BETA-CLOTH OR EQUIVALENT MATERIAL. SUBMIT TO THE LEVEL II PRCB FOR MODIFICATION IMPLEMENTATION IN OV-102. CATEGORY 2.	09/01/86 JSC-AE	
	2 2		JSC-VA 1-2 S		09/01/86 JSC-AE	
	2 2		JSC-VA 1-3 S		09/01/86 JSC-AE	

REPORT NO. 2102-2

S D R I S T A T U S
CATEGORY 2 OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60167	2 2	ET UMBILICAL DOOR CLOSURE	JSC-VA 1-1 S	REVIEW STATUS OF TWO-FAULT-TOLERANCE CAPABILITY FOR ORBITER SYSTEMS AND PROVIDE IMPACTS TO DEVELOP THE CAPABILITY FOR THOSE CASES WHERE IT DOES NOT PRESENTLY EXIST. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 2.	07/25/86 JSC-AE	
60172	2 2	OPERATIONAL INSTRU MENTATION FOR POGO .ASSESSMENT	JSC-VA 1-1 S	DETERMINE STATUS OF INSTALLATION OF POGO MEASUREMENT INSTRUMEN-TATION FOR ALL ORBITERS. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 2.	07/25/86 JSC-AE	

REPORT NO. 2102-2

S D R I   S T A T U S
CATEGORY 2 OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60174	2 2	NLG BUNGEE LATCH	JSC-VA 1-1 S	DEVELOP IMPACTS FOR DE-SIGN IMPROVEMENTS OF THE NLG RIGGING MECHANISM, INCLUDING PROVISIONS TO ENSURE POSITIVE INDICA-TION AND REPEATABILTY OF PROPER RIGGING. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 2.	07/31/86 KSC-NE	
60187	2 2	OME FEEDLINE TO BI -PROPELLANT FLANGE LEAKAGE	JSC-VA 1-1 S	REVIEW ALTERNATE SEAL CONFIGURATIONS FOR RESOLUTION OF THE LEAKAGE OF PROPELLANT VAPORS THROUGH THE BI-PROPELLANT VALVE FLANGE SEAL AND PROVIDE RECOMMENDED RESOLUTION, INCLUDING IMPACTS, TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).CATEGORY 2	07/31/86 KSC-NE	

REPORT NO. 2102-2

S D R I   S T A T U S
CATEGORY 2 OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60188	2 2	LEAK OF HOT EXHAUST GAS @ APU EXHAUST DUCT PURGE CONN	JSC-VA 1-1 S	IMPLEMENT DELETION OF THE EXHAUST DUCT PURGE FITTING IN YOUR PROJECT AND ISSUE APPROPRIATE DIRECTION TO YOUR CONTRACTOR. CATEGORY 2.	07/31/86 KSC-NE	
	2 2		JSC-GM13 3-1 S	UPDATE THE BARS MKK REPORT TO REFLECT DELETION OF THE EXHAUST DUCT PURGE FITTING. CATEGORY 2.	07/31/86 KSC-NE	
60188 R1	2 2	POSSIBLE LEAKAGE HOT EXHAUST GASES FROM APU EXHAUST	JSC-VA 1-1 S	PROVIDE MODIFICATION HARDWARE AND ENGINEERING TO ACCOMPLISH DELETION OF THE EXHAUST DUCT PURGE FITTING. SUBMIT TO THE LEVEL II PRCB FOR MODIFICATION IMPLEMENTATION IN OV-103. CATEOGRY 2.	09/01/86 KSC-NE	
	2 2		JSC-VA 1-2 S		09/01/86 KSC-NE	

REPORT NO. 2102-2

S D R I S T A T U S
CATEGORY 2 OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60189	2 2	WATER SPRAY BOILER EXHAUST DUCT TEMP SENSOR LIMITS	JSC-VA 1-1 S	EXAMINE IMPROVEMENTS FOR PROVIDING POSITIVE VERIFICATION OF PROPER WSB EXHAUST DUCT HEATER OPERATION. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 2.	07/31/86 KSC-NE	
60191	2 2	ORB GSE HEAT EXCHA NGER FOR RTG PAYLO AD FLIGHTS	JSC-VA 1-1 S	REVIEW USE OF ALTERNATE COOLANT FLUIDS IN RTG COOLANT LOOP. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 2.	07/31/86 KSC-NE	
	2 2		JSC-TE 1-2 S		07/31/86 KSC-NE	

REPORT NO. 2102-2

S D R I S T A T U S
CATEGORY 2 OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60191	2 2		JSC-VA 2-1 S	PROPOSE RESOLUTION TO PRECLUDE FREEZE UP OF THE GSE HEAT EXCHANGER WHEN RTG COOLANT WATER CIRCULATION IS LOST. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 2.	07/31/86 KSC-NE	
60195	2	HYDRAULIC COMPONENT CONTAMINATION	JSC-VA 2-1 S	REVIEW RECOMMENDATIONS AND FINDINGS OF THE ORBITER HYDRAULIC SYSTEM CLEANLINESS REVIEW TEAM. INCLUDE STATUS OF IMPLEMENTATION AND CURRENT APPLICATIONS. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 2.	07/31/86 KSC-NE	

PAGE NO. 23
DATE 08/11/86

REPORT NO. 2102-2

S D R I S T A T U S
CATEGORY 2 OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60196	2 2	.PASS AND BFS ERRO R MESSAGES	JSC-VA 1-1 S	REVIEW PRESENT USERS GUIDE AND DEVELOP HELP DOCUMENT TO AID IN THE UNDERSTANDING OF ERROR MESSAGES AND PLACE UNDER CONFIGURATION CONTROL. CATEGORY 2.	07/31/86 KSC-NE	
	2 2		JSCGA/OASCB 1-2 S		07/31/86 KSC-NE	
60210	2 2	PHOTO OPTICAL SYST EM UPGRADES	JSC-GA 1-1 S	DETERMINE APPROPRIATE ACTIVITY FOR REDEFINI- TION OF LAUNCH SITE PHOTOGRAPHIC/TELEVISION REQUIREMENTS. CATEGORY 2.	12/14/87 KSC-GM	

REPORT NO. 2102-2

S D R I S T A T U S
CATEGORY 2 OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60245	2 2	RMS MCIU MODIFICATION AND REQUALIFICATION	JSC-VA 1-1 S	ASSESS NUMBER OF MCIU'S REQUIRED GIVEN 3 OR 4 ORBITERS IN THE FLEET AND CONSIDERATIONS OF FLYING WITH OR WITHOUT A SPARE MCIU. PROVIDE APPROPRIATE IMPACTS. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 2.	08/15/86 JSC-VA	
	2 2		JSC-TA 2-1 S	DETERMINE MANIFEST CONDITIONS UNDER WHICH A SPARE MCIU WOULD BE REQUIRED TO FLY. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 2.	08/15/86	

REPORT NO. 2102-2

SDRI STATUS
CATEGORY 2 OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60245	2 2		JSC-VA 3-1 S	DETERMINE TOTAL COST IMPACT FOR THE CONCEPTUAL REDESIGN OF THE MCIU, INCLUDING ASSOCIATED SOFTWARE IMPACTS AND ORBITER WIRING AND ANNUNCIATION CONSIDERATIONS. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 2.	08/15/86 JSC-VA	
	2 2		JSC-VA 4-1 S	ASSESS COST OF REPLACING LOST MCIU'S WITH FUNCTIONALLY IDENTICAL UNITS. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 2.	08/15/86 JSC-VA	
	2 2		JSC-DA 5-1 S	PROVIDE RECOMMENDATIONS RELATIVE TO MCIU REDESIGN EFFORT, INCLUDING TRAINER AND SIMULATOR IMPACTS. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 2.	08/15/86 JSC-VA	

REPORT NO. 2102-2

S D R I   S T A T U S
CATEGORY 2 OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60246	2 2	RMS END EFFECTOR MODIFICATION AND REQUALIFICATION	JSC-VA 1-1 S	DETERMINE RMS END EFFECTOR MODIFICATIONS REQUIRED TO ACHIEVE FINAL CONFIGURATION DESIRED. PROVIDE APPROPRIATE IMPACTS. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 2.	08/15/86	
	2 2		JSC-VA 2-1 S	ASSESS DOD REQUIREMENTS RELATIVE TO A RMS END EFFECTOR WITH FULL ELECTRICAL REDUNDANCY AND THEIR ABILITY TO SHARE RESPONISBILITY FOR ASSOCIATED COST. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 2.	08/15/86	

REPORT NO. 2102-2

SDRI STATUS
CATEGORY 2 OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60248	2 2	POTENTL LOSS OF EMU SUIT DUE TO LKGE OF DISCNT/BEAR SLS	JSC-GM 1-1 S	COORDINATE A CENTER LEVEL REVIEW FOR FURTHER ASSESSMENT REGARDING THE POTENTIAL LOSS OF EMU SUIT PRESSURE DUE TO EXCESSIVE LEAKAGE OF DISCONNECTS AND BEARING SEALS. CATEGORY 2.	09/15/86 JSC-EA	
60249	2 2	POTENTL LOSS EMU SUIT DUE TO GIMBAL PVT/BELLOW SEP FLR	JSC-GM 1-1 S	COORDINATE A CENTER LEVEL REVIEW FOR FURTHER ASSESSMENT REGARDING THE POTENTIAL LOSS OF EMU SUIT DUE TO GIMBAL PIVOT OR BELLOWS SEPARATION FAILURE. CATEGORY 2.	09/15/86 JSC-EA	
60250	2 2	POTENTL LOSS EMU EMERGENCY OXYGEN SUPPLY	JSC-GM 1-1 S	COORDINATE A CENTER LEVEL REVIEW FOR FURTHER ASSESSMENT REGARDING THE POTENTIAL LOSS OF THE EMU EMERGENCY OXYGEN SUPPLY. CATEGORY 2.	09/15/86 JSC-EA	

REPORT NO. 2102-2

S D R I S T A T U S
CATEGORY 2 OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60253	2 2	THIN WALLED OMS EN GINE NOZZLES	JSC-VA 1-1 S	DEVELOP OPERATIONAL HARDWARE AND LOGISTICS PLANNING REQUIREMENTS TO ACCOMMODATE DELETION OF THIN WALL OME NOZZLES FROM THE PROGRAM. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 2	09/15/86 JSC-AM	
60254	2 2	SINGLE SSME ROLL C ONTROL NOT AVAILAB LE IN THE BFS	JSC-VA 1-1 S	REVIEW INCORPORATION OF SINGLE SSME ROLL CONTROL CAPABILITY, S/W CR 39223A, IN THE BFS AND PROVIDE APPROPRIATE IM- PACTS. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 2.	09/15/86 JSC-AM	

REPORT NO. 2102-2

S D R I   S T A T U S
CATEGORY 2 OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60258	2 2	.WATER SPRAY BOILER CONTROLLER B INSTRUMENTATION	JSC-VA 1-1 S	DETERMINE BEST IMPLEMENTATION PLAN, WITH MINIMUM IMPACT, TO PROVIDE FULL INSTRUMENTATION FOR WATER SPRAY BOILER CONTROLLER "B" IN ORDER TO HAVE SAME CAPABILITY IN BOTH CONTROLLERS. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 2.	09/15/86 JSC-AM	
60259	2 2	ET DOOR CLOSURE SOFTWARE IN OPS 3	JSC-VA 1-1 S	INVESTIGATE THE POSSIBILITY OF INCORPORATING THE CAPABILITY TO CLOSE THE ET DOOR IN THE OPS 3 SOFTWARE FOR THE NEXT FLIGHT. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 2.	09/15/86 JSC-AM	

REPORT NO. 2102-2

S D R I S T A T U S
CATEGORY 2 OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60260	2 2	VENT DOOR CLOSURE IN MM305	JSC-DA 1-1 S	SUBMIT APPROPRIATE SOFT-WARE CHANGE REQUEST TO DELETE PFS CAPABILITY TO CLOSE VENT DOORS IN MM305. CATEGORY 2.	09/15/86 JSC-AM	
60261	2 2	VENT DOORS 4 AND 7 NO LONGER REQUIRED	JSC-VA 1-1 S	DEVELOP A POSITION RE-LATIVE TO REMOVAL OF VENT DOORS 4 AND 7 AND/OR REMOVAL OF ASSOCIATED WING VENT DUCTS, ACTUA-TORS AND MOTORS. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 2.	09/15/86 JSC-AM	

PAGE NO. 1
DATE 08/11/86

REPORT NO. 2102-3

S D R I   S T A T U S
CATEGORY 3 OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60037	3 3	FUEL CELL HEAT EXC HANGER FAILURE	JSC-VA 1-1 S	PROVIDE RECOMMENDED MECHANIZATION FOR SEP- ARATION OF FUEL CELL LOOPS AND IDENTIFY RELATED COST AND SCHED- ULE IMPACTS. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	05/05/86	

REPORT NO. 2102-4

S D R I   S T A T U S
UNCATEGORIZED OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60002		GO2 FLOW CONTROL VALVE PARTICLE IMPACT EFFECTS	JSC-VA 1-1 S	CONDUCT A THOROUGH ANALYSIS OF DESIGN CONSIDERATIONS FOR NON-ACTIVE FLOW CONTROL DEVICES IN OXYGEN SYSTEMS. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	04/16/86 JSC-AM	
			JSC-VA 2-1 S	ASSESS SCHEDULE/COST IMPACTS OF IMPLEMENTING A REDESIGNED LO2 FLOW CONTROL VALVE. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	04/16/86 JSC-AM	
			JSC-VA 3-1 S	ASSESS FRETTING WEAR ON QUAL/FLIGHT HARDWARE AS EXPERIENCED DURING THE PROGRAM. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	04/16/86 JSC-AM	

REPORT NO. 2102-4

S D R I   S T A T U S
UNCATEGORIZED OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60002			JSC-VA 4-1 S	REVIEW GH2 FCV UTILIZATION OF THE SINGLE SEAL CONFIGURATION AND ASSESS POTENTIAL GO2 FCV APPLICATION. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	04/16/86 JSC-AM	
60003		LOSS OF ACTIVATION OF PROPELLANT FILL AND DRAIN VALVES	JSC-VA 1-1 S	REASSESS CRITICALITY OF PROPER OPERATION OF H2 VENT VALVES FOR ABORTS. INCLUDE RATIONALE FOR CHANGE BEFORE STS 41-D AND IMPACTS OF BURNING H2 ON LATEST (WTR) CONFIGURATION OMS PODS. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	04/16/86 JSC-AM	

REPORT NO. 2102-4

S D R I S T A T U S
UNCATEGORIZED OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60003			JSC-AM 2-1 S	PERFORM COMPLETE ASSESSMENT OF CHANGES WITHIN THE ELECTRICAL/FLUID/ PNEUMATIC/AVIONICS/ MECHANICAL SYSTEMS TO ENSURE CONSISTENT TREATMENT OF REDUNDANCY AND RELIABILITY CONSIDERATIONS. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	04/16/86 JSC-AM	
60006		ET ULLAGE PRESSURE TRANSDUCER STICTION PROBLEMS	MSFC-ET 2-1 S	PROVIDE ASSESSMENT OF THE FEASIBILITY/SAFETY/ ACCEPTABILITY OF SSME SHUTDOWN WITH ONLY ONE GOOD FLOW CONTROL VALVE. PROVIDE A RECOMMENDATION REGARDING THE STANDARDIZATION OF ULLAGE PRESSURE DECAY PROJECTIONS IN TERMS OF DESIGN REFERENCE VERSUS MISSION SPECIFIC CONSIDERATIONS. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	04/16/86 JSC-AM	

REPORT NO. 2102-4

S D R I S T A T U S
UNCATEGORIZED OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60006			MSFC-SSME 2-2 S		04/16/86 JSC-AM	
			JSC-TE 2-3 S		04/16/86 JSC-AM	
			JSC-AM 2-4 S		04/16/86 JSC-AM	
			JSC-AM 3-1 S	COMPARE FAILURE MODES OF EXISTING TRANSDUCER DESIGN VS ELECTRONIC TRANSDUCER CURRENTLY UNDER DEVELOPMENT AND RECONSIDER RECOMMENDATION TO REPLACE EXISTING TRANSDUCER WITH NEW DESIGN. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	04/16/86 JSC-AM	

REPORT NO. 2102-4

S D R I   S T A T U S
UNCATEGORIZED OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60006			JSC-TE 4-1 S	ASSESS REVISION OF LCC TO REQUIRE 3 OR 3 ET LH2 ULLAGE PRESSURE TRANS-DUCERS WITHIN LIMITS UNTIL T-0. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	04/16/86 JSC-AM	
60006 R1		ET ULLAGE PRESSURE TRANSDUCER STICTIO N PROBLEMS	JSC-GA/M 2-1 S	REVIEW CRITICALITY OF LH2 FLOW CONTROL VALVE SWITCH, SPECIFICALLY INCLUDING THE POSSIBILI-TY OF SHORT CIRCUITS INVOLVING MUTLIPLE CONTACTS.	05/29/86 JSC-AM	
			JSC-TE 3-1 S	WITH THE PSIG, DETERMINE IMPACTS OF IMPLEMENTING A VOTING LOGIC SCHEME FOR CONTROL OF THE FLOW CONTROL VALVE. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	05/29/86 JSC-AM	

REPORT NO. 2102-4

S D R I S T A T U S
UNCATEGORIZED OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60010		INDIVIDUAL LIMIT LOGIC INHIBITING FOR EACH SSME	JSC-CA 1-1 S	ASSESS HARDWARE/SOFTWARE OPTIONS AND RELATIVE IMPACTS FOR INHIBITING LIMIT LOGIC FOR INDIVIDUAL SSME'S. REPORT RESULTS AND PROVIDE RECOMMENDATIONS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	04/21/86 JSC-AM	
			JSC-DA 1-2 S		04/21/86 JSC-AM	
			JSC-VA 1-3 S		04/21/86 JSC-AM	

REPORT NO. 2102-4

SDRI STATUS
UNCATEGORIZED OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60010			JSCGA/OASCB 2-1 S	DEVELOP MANPOWER/SCHEDULE/COST AND OTHER IMPACTS ASSOCIATED WITH THIS CHANGE IN CONJUNCTION WITH AN ONGOING OVERALL AVIONICS SOFTWARE REVIEW RECOMMENDATION REGARDING THIS CHANGE WILL BE DEVELOPED BY THE OASCB. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB SYSTEM DESIGN REVIEW BOARD).	04/21/86 JSC-AM	
			JSC-VA 2-2 S		04/21/86 JSC-AM	
60013		MANUAL MPS DUMP CAPABILITY	JSC-VA 1-1 S	DETERMINE IMPACTS OF HARDWARE, SOFTWARE AND PROCEDURES OPTIONS FOR INSURING MANUAL MPS DUMP CAPABILITY. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	05/01/86 JSC-AM	

REPORT NO. 2102-4

SDRI STATUS
UNCATEGORIZED OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60013			JSCGA/OASCB 2-1 S	DEVELOP MANPOWER/SCHEDULE/COST AND OTHER IMPACTS ASSOCIATED WITH THIS CHANGE IN CONJUNCTION WITH AN OVERALL AVIONICS SOFTWARE REVIEW RECOMMENDATIONS REGARDING THIS CHANGE WILL BE DEVELOPED BY THE OASCB. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	05/01/86 JSC-AM	
			JSC-VA 2-2 S		05/01/86 JSC-AM	

REPORT NO. 2102-4

S D R I S T A T U S
UNCATEGORIZED OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60015		CONTAINMENT SHIELD FOR SSME	JSC-TA 1-1 S	RE-REVIEW SUBJECT OF SSME CONTAINMENT WITH REGARD TO CONTAINMENT OF FRAGMENTS, OVER PRESSURE AND FIRE, INCLUDING THE DEVELOPMENT OF FAILURE SCENARIOS. REPORT RESULTS AND PROVIDE RE-COMMENDATIONS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	06/25/86 JSC-AM	
			JSC-VA 2-1 S	ASSESS FEASIBILITY OF ORBITER MODIFICATIONS TO MINIMIZE DAMAGE FROM OVER PRESSURE. REPORT RESULTS AND PROVIDE RECOMMENDATIONS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	06/25/86 JSC-AM	

REPORT NO. 2102-4

S D R I S T A T U S
UNCATEGORIZED OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60017		ADD RCS PROPELLANT OVER PRESSURIZATIO N TO OPS 1,3 & 6	JSCGA/OASCB 2-1 S	DEVELOP MANPOWER/SCHE-DULE/COST AND OTHER IMPACTS ASSOCIATED WITH THIS CHANGE IN CONJUNC-TION WITH AN OVERALL AVIONICS SOFTWARE REVIEW RECOMMENDATIONS REGARD-ING THIS CHANGE WILL BE DEVELOPED BY THE OASCB. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	05/15/86 JSC-DA	
			JSC-VA 2-2 S		05/15/86 JSC-DA	
60019		RCS SOLENOID VALVE CONTINUOUS COIL PO WER	JSC-VA 1-1 S	REVIEW AND ASSESS THREAT TO SAFETY OF VEHICLE, FLIGHT CREW, AND GROUND CREW OF POSSIBLE FAILED -ON VALVE (CONTINUOUSLY POWERED) IN MMH ENVIRON-MENT. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	04/21/86 JSC-DA	

REPORT NO. 2102-4

S D R I S T A T U S
UNCATEGORIZED OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60020		OMS/RCS AC MTR VLV BELLOWS LEAKAGE/VAPOR DETONATION	JSC-VA 1-1 S	REVIEW AND ASSESS POSSIBLE BELLOWS LEAKAGE AND POSSIBILITY OF DETONATION IF LEAKAGE OCCURS IN CONJUNCTION WITH CONTINUOUS POWER TO VALVES. CONSIDER PERFORMING PROPELLANT EXPOSURE TESTS AND/OR ANALYSIS WITH CONTINUOUS VALVE POWER APPLIED TO THE OMS/RCS AC MOTOR ACTUATORS. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	04/21/86 JSC-DA	
60022		CR 79194H OMS SOFTWARE GAGING	JSC-VA 1-1 S	IMPLEMENT CR 79194H, OMS SOFTWARE GAGING, PENDING FINAL OASCB APPROVAL. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	04/21/86 JSC-DA	

REPORT NO. 2102-4

SDRI STATUS
UNCATEGORIZED OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60022			JSCGA/OASCB 2-1 S	DEVELOP MANPOWER/SCHEDULE/COST AND OTHER IMPACTS ASSOCIATED WITH THIS CHANGE IN CONJUNCTION WITH AN OVERALL AVIONICS SOFTWARE REVIEW. RECOMMENDATIONS REGARDING THIS CHANGE WILL BE DEVELOPED BY THE OASCB. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	05/15/86 JSC-DA	
			JSC-VA 2-2 S		05/15/86 JSC-DA	

REPORT NO. 2102-4

S D R I   S T A T U S
UNCATEGORIZED OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60023		INSTR. PANEL REACH AND VISIBILITY DURING ASCENT	JSCGA/OASCB 2-1 S	DEVELOP MANPOWER/SCHEDULE/COST AND OTHER IMPACTS ASSOCIATED WITH THIS CHANGE IN CONJUNCTION WITH AN OVERALL AVIONICS SOFTWARE REVIEW. RECOMMENDATIONS REGARDING THIS CHANGE WILL BE DEVELOPED BY THE OASCB. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	05/06/86 JSC-DA	
			JSC-VA 2-2 S		05/06/86 JSC-DA	
			JSC-DA 3-1 S	REVIEW AND VERIFY ALL CREW PROCEDURES, IDENTIFYING ANY ADDITIONAL PROCEDURES THAT HAVE REACH AND VISIBILITY PROBLEMS. CONSIDER ASCENT, ON-ORBIT, AND ENTRY FLIGHT REQUIREMENT REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	05/06/86 JSC-DA	

REPORT NO. 2102-4

S D R I S T A T U S
UNCATEGORIZED OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60024		ADD PFS SPEC 23 (RCS MANAGEMENT) TO OPS 1/6	JSCGA/OASCB 2-1 S	DEVELOP MANPOWER/SCHEDULE/COST AND OTHER IMPACTS ASSOCIATED WITH THIS CHANGE IN CONJUNCTION WITH AN OVERALL AVIONICS SOFTWARE REVIEW. RECOMMENDATIONS REGARDING THIS CHANGE WILL BE DEVELOPED BY THE OASCB. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	05/06/86 JSC-DA	
			JSC-VA 2-2 S		05/06/86 JSC-DA	
60030		APU CONTAINMENT SHIELD	JSC-EA 1-1 S	ASSESS FEASIBILITY OF PROVIDING SHIELDING BETWEEN APU'S 1 AND 2. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	05/06/86 JSC-AM	

REPORT NO. 2102-4

SDRI STATUS
UNCATEGORIZED OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60030			JSC-VA 2-1 S	ASSESS FEASIBILITY OF PROTECTING SIGNIFICANT EXPOSED WIRING LINES AND OTHER EQUIPMENT. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	05/06/86 JSC-AM	
60032 R1		APU AUTO SHUTDOWN INHIBIT FUNCTION	JSC-VA 1-1 S	IMPLEMENT INSTALLATION OF A SEPARATE APU SHUT-DOWN INHIBIT SWITCH FOR EACH APU IN YOUR PROJECT ISSUE APPROPRIATE DIRECTION TO YOUR CONTRACTOR.	08/08/86 JSC-AM	
60032 R2		APU AUTO SHUTDOWN INHIBIT FUNCTION	JSC-VA 1-1 S	PROVIDE MODIFICATION HARDWARE AND ENGINEERING TO ACCOMPLISH INSTALLA-TION OF A SEPARATE APU SHUTDOWN INHIBIT SWITCH FOR EACH APU. SUBMIT TO THE LEVEL II PRCB FOR MODIFICATION IMPLEMETA-TION IN OV-102.	09/01/86 JSC-AM	

REPORT NO. 2102-4

S D R I   S T A T U S
UNCATEGORIZED OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60032 R2			JSC-VA 1-2 S		09/01/86 JSC-AM	
			JSC-VA 1-3 S		09/01/86 JSC-AM	
60034		UNCOMMANDED BRAKE PRESSURE	JSC-VA 1-1 S	DEVELOP A RECOMMENDATION INCLUDING COST/SCHEDULE IMPACTS, FOR ELIMINATION OF RISKS ASSOCIATED WITH EXCESSIVE UNCOMMANDED BRAKE PRESSURE. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	05/06/86 JSC-AM	
			JSC-VA 3-1 S	DEVELOP A PLAN TO ENSURE THAT THE SODB WILL BE CONSISTENT WITH THE DECISIONS OF THE SYSTEM DESIGN REVIEW BOARD. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	05/06/86 JSC-AM	

REPORT NO. 2102-4

S D R I S T A T U S
UNCATEGORIZED OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60035		LANDING/DECELERATION SYSTEM CAPABILITY	JSC-VA 1-1 S	PROVIDE STATUS OF ALL ONGOING BRAKE IMPROVEMENT ACTIVITIES. DETERMINE IF ALL CURRENT IMPROVEMENTS ARE BEING PURSUED AT THE MAXIMUM PACE OF THE PROGRAM AND WHETHER ADDITIONAL OPTIONS SHOULD BE CONSIDERED. INCLUDE INVESTIGATION OF ELIMINATING APPARENT 60/40 ENERGY DISTRIBUTION BETWEEN THE INBOARD AND OUTBOARD BRAKES.REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	05/08/86 JSC-AM	
			JSC-DA 1-2 S		05/08/86 JSC-AM	
			JSC-EA 1-3 S		05/08/86 JSC-AM	

REPORT NO. 2102-4

SDRI STATUS
UNCATEGORIZED OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60035			JSC-VA 15-1 S	ASSESS ADEQUACY AND CHARACTERISTICS OF THE ANTI-SKID SYSTEM. INCLUDE THE 30-HERTZ BRAKE OSCILLATION APPARENTLY INDUCED BY THE ANTI-SKID SYSTEM. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	05/08/86 JSC-AM	
			KSC-SE 16-1 S	ASSESS DESIRABILITY AND POSSIBLE METHODS OF IN-FLIGHT MONITORING OF PNEUMATIC PRESSURE IN MLG STRUTS. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	05/08/86 JSC-AM	
			JSC-VA 16-2 S		05/08/86 JSC-AM	

REPORT NO. 2102-4

S D R I   S T A T U S
UNCATEGORIZED OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60035			JSC-AM 9-1 S	DETERMINE OPTIMUM TAL ABORT RUNWAYS, INCLUDING ANY UPGRADES REQUIRED. RUNWAY CONSIDERATIONS WILL BE LIMITED ONLY BY LAUNCH AZIMUTH AND NOMI- NAL ABORT CROSS RANGE/ DOWN RANGE CAPABILITIES. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	05/08/86 JSC-AM	
60035 R2		LANDING/DECELERATI ON SYSTEM CAPABILI TY	JSC-VA 1-1 S	INCORPORATE POTENTIAL FOR HEAVIER ORBITER DOWN WEIGHT RESULTING FROM 6.0 LOAD ASSESSMENTS, INTO BRAKING TEST/EVAL- UATION. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	07/11/86 JSC-AM	

REPORT NO. 2102-4

S D R I   S T A T U S
UNCATEGORIZED OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60035 R2			JSC-VA 2-1 S	EVALUATE POTENTIAL REQU-IREMENTS FOR THERMAL ISOLATION OF HYDRAULIC SYSTEM COMPONENTS AND/OR ACTIVE COOLING (RE: CARBON BRAKES). REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	07/11/86 JSC-AM	
			JSC-VA 3-1 S	CONDUCT FURTHER BRAKING TEST WITH CONSIDERATIONS OF MAXIMUM BRAKE PRESS-URE APPLICATION WITHIN THE MINIMUM RESPONSE TIME BY CREW MEMBERS, CONSIDERING KNOWN POST FLIGHT PHYSIOLOGICAL CAPABILITIES. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	07/11/86 JSC-AM	

REPORT NO. 2102-4

S D R I S T A T U S
UNCATEGORIZED OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60035 R3		LANDING/DECELERATION SYSTEM CAPABILITY	JSC-EA 1-1 S	RE-EVALUATE BASELINE DATA/CRITERIA UTILIZED IN ORIGINAL TIRE SELECTION. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	07/11/86 JSC-AM	
			JSC-VA 4-1 S	ASSURE THAT ALL ENGINEERING MODELS ARE BASELINED THROUGH THE FORMAL ORBITER CONFIGURATION CONTROL BOARD PRIOR TO UTILIZATION. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	07/11/86 JSC-AM	
			JSC-DA 4-2 S		07/11/86 JSC-AM	
			JSC-EA 4-3 S		07/11/86 JSC-AM	
			JSC-TA 4-4 S		07/11/86 JSC-AM	

REPORT NO. 2102-4

S D R I S T A T U S
UNCATEGORIZED OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60035 R3			JSC-AM 5-1 S	INCLUDE IN OVERALL RE-VIEW OF CONTINGENCY/TAL ABORT RUNWAYS CONSIDERA-TIONS FOR GROOVING THESE RUNWAYS, INCLUDING VLS. REPORT RESULTS TO SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	07/11/86 JSC-AM	
			JSC-VA 6-1 S	REVIEW /DEVELOP OPTIONS FOR ACHIEVING WHEEL SPIN -UP PRIOR TO LANDING. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	07/11/86 JSC-AM	
			JSC-VA 8-1 S	INCLUDE IN CARBON BRAKE DEVELOPMENT, CONSIDERA-TION OF THE UTILIZATION OF LARGER WHEEL TIE BOLTS AND EXAMINE FEAS-IBILITY OF ADDITIONAL TIE BOLTS VS LARGER TIE BOLTS. REPORT RESULTS TO THE SPECIAL LEVEL II FRCB (SYSTEM DESIGN REVIEW BOARD).	07/11/86 JSC-AM	

REPORT NO. 2102-4

SDRI STATUS
UNCATEGORIZED OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60036 R1		LOSS OF WATER REMOVAL CAPABILITY FOR FUEL CELLS	JSC-VA 1-1 S	SUBMIT RCN TO UPDATE OMRSD, AS APPROPRIATE, TO PERFORM NOZZLE FLOW TESTS AS LATE AS POSSIBLE IN TURNAROUND AND VERIFY THAT VEHICLE OPENINGS ARE FREE AND CLEAR OF OBSTRUCTIONS.	05/22/86 JSC-AM	
60038		FUEL CELL INSTRUMENTATION RECHANNELIZATION	JSC-VA 1-1 S	REPORT APPROPRIATE IMPLEMENTATION PLANNING AND IDENTIFY ASSOCIATED COST AND SCHEDULE IMPACTS. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	05/05/86 JSC-AM	
			JSC-CA 3-1 S	IMPLEMENT RECHANNELIZATION OF FUEL CELL INSTRUMENTATION IN YOUR ACTIVITY.	05/05/86 JSC-AM	
			JSC-DA 3-2 S		05/05/86 JSC-AM	

REPORT NO. 2102-4

SDRI STATUS
UNCATEGORIZED OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60038 R1		FUEL CELL INSTRUMENTATION RECHANNELIZATION	JSC-VA 1-1 S	PROVIDE MODIFICATION HARDWARE AND ENGINEERING TO RECHANNEL FUEL CELL INSTRUMENTATION. SUBMIT TO THE LEVEL II PRCB FOR MODIFICATION IMPLEMENTATION IN OV-102.	09/01/86 JSC-AM	
			JSC-VA 1-2 S		09/01/86 JSC-AM	
			JSC-VA 1-3 S		09/01/86 JSC-AM	
60044		RADIATOR ISOLATION	JSC-VA 1-1 S	PROPOSE IMPLEMENTATION PLAN FOR PROVIDING LEAK ISOLATION CAPABILITY TO BOTH RADIATOR/PLUMBING SYSTEMS. INCLUDE DESIGN CONSIDERATIONS AND SCHEDULE/COST IMPACTS. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	05/08/86 JSC-AM	

REPORT NO. 2102-4

SDRI STATUS
UNCATEGORIZED OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60048		SPLIT-S RTLS CAPABILITY FOR EARLY LOSS, 2 OR 3 SSME'S	JSC-VA 3-1 S	EVALUATE MODIFICATIONS TO THE SHUTTLE ENGINEERING SIMULATOR TO ACCOMODATE TESTING ASSOCIATED WITH VERIFICATION OF THE SPLIT-S RTLS ABORT CAPABILITY. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	05/08/86 JSC-AM	
60053		H2 LEAKAGE FROM ET /ORB UMB DURNG GRND LOAD/COND OR FLT	JSC-VA 1-1 S	DETERMINE SCOPE OF SECONDARY SEAL CERTIFICATION PROGRAM FOR THE 4" AND 17" DISCONNECTS AND ANY SECONDARY SEALS OF OTHER VALVES WHICH HAVE NOT BEEN CERTIFIED. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	05/19/86 JSC-EA	

REPORT NO. 2102-4

S D R I S T A T U S
UNCATEGORIZED OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60053			JSC-VA 2-1 S	ASSESS COST/SCHEDULE IMPACTS OF IMPLEMENTING A HAZARDOUS GAS DETECT-ION SYSTEM FOR THE ET/ ORBITER UMBILICAL CAVITY REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	05/19/86 JSC-EA	
60053 A		HYDROGEN LEAKAGE FROM ET/ORB UMBILI CAL (REF S60053)	KSC-GM 1-1 S	IMPLEMENT THIS CHANGE IN YOUR PROJECT GATHERING ADDITIONAL FLT VEHICLE DATA TO DETERMINE THE SYSTEM INLET AND OUTLET FLOWRATE CHARACTERISTICS AS INPUT FOR DESIGN CONCEPTS ASSOCIATED WITH A HAZARDOUS GAS DETECTION SYSTEM ON OV-104.	08/11/86 JSC-VA	

REPORT NO. 2102-4

S D R I S T A T U S
UNCATEGORIZED OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60053 R2		H2 LEAKAGE FROM ET /ORB UMBILICAL LOA D/COND OR FLIGHT	KSC-NE 1-1 S	ASSESS COST/SCHEDULE IMPACTS OF IMPLEMENTING ADDED HAZARDOUS GAS DET-ECTION SYSTEM CAPABILITY AT KSC AND VLS FOR 17-INCH UMBILICAL CAVITY H2 LEAKAGE DETECTION AND/OR THE ADDITION OF A PRES-SURE MEASUREMENT TO EACH UMBILICAL CAVITY FOR VERIFICATION OF SEAL IN-TEGRITY. INCLUDE RE-QUIREMENTS FOR SENSING AND TRANSMITTING INDICA-TIONS TO THE OVERALL MONITORING SYSTEM.REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SDRB).	07/25/86 JSC-AE	
			USAF-VLS 1-2 S		07/25/86 JSC-AE	

REPORT NO. 2102-4

S D R I S T A T U S
UNCATEGORIZED OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60053 R2			JSC-VA 2-1 S	ASSESS COST/SCHEDULE IMPACTS OF IMPLEMENTING A HAZARDOUS GAS DETEC-TION SYSTEM AND/OR PRESSURE SENSOR FOR THE ET/ORBITER UMBILICAL CAVITY. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	07/25/86 JSC-AE	
60055		LO2/LH2 PREVALVE C LOSURE DURING FLOW	JSC-VA 1-1 S	DEFINE A TEST PROGRAM FOR CERTIFICATION OF THE LO2 AND LH2 PREVALVES WITH THE OPEN ACTUATOR VENTED ASSESS RELATED COST AND SCHEDULE IMPACTS. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	05/19/86 JSC-AE	

REPORT NO. 2102-4

S D R I S T A T U S
UNCATEGORIZED OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60057		SSME #2 GH2 PRESS SYS PRESSURE SENSOR (V41P1260A) FAIL	JSC-VA 1-1 S	DEVELOP COST AND SCHEDULE IMPACTS TO CHARACTERIZE DYNAMICS OF THE LH2 PRE-PRESSURIZATION/PRESSURIZATION SYSTEM ENVIRONMENT RELATIVE TO FAILURE OF THE SSME #2 GH2 PRESSURIZATION SYSTEM PRESSURE SENSOR AND OTHER SYSTEM ELEMENTS THAT MAY BE AFFECTED. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	05/19/86 JSC-AE	
60059		APU FUEL LEAK DETECTION WHILE RUNNING	JSC-EA 1-1 S	PROVIDE NECESSARY CRITERIA FOR DESIGN OF APU FUEL LEAK DETECTION CAPABILITY. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	05/22/86 JSC-AE	

REPORT NO. 2102-4

S D R I   S T A T U S
UNCATEGORIZED OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60059			JSC-VA 2-1 S	DEVELOP A SPECIFIC PLAN FOR PROVIDING FUEL LEAK DETECTION CAPABILITY IN THE APU SYSTEM DURING OPERATION CONSIDERING ALL POSSIBLE FAILURE MODES. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	05/22/86 JSC-AE	
60060		EXHAUST DUCT HOT GAS LEAKAGE INTO AFT COMPARTMENT	JSC-VA 1-1 S	PROVIDE PLAN AND ASSESS IMPACTS RELATIVE TO PERFORMING A MATERIALS AND PROCESS INSPECTION ON A CROSS SECTION OF AN OV-102 APU EXHAUST DUCT, REPLACEMENT OF THE DUCT UTILIZED FOR THE INSPECTION AND CONSIDERATIONS FOR REQUALIFICATION OF THE DUCT TO A HIGHER TEMPERATURE SPECIFICATION. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	05/22/86 JSC-AE	

REPORT NO. 2102-4

S D R I   S T A T U S
UNCATEGORIZED OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60060			JSC-VA 2-1 S	IMPLEMENT TEAR DOWN AND MATERIALS AND PROCESS OF THE APU EXHAUST DUCT IN YOUR PROJECT AND ISSUE APPROPRIATE DIRECTION TO YOUR CONTRACTOR.	12/25/86 JSC-AE	
60062		OVERSPEED CONTROL SAFETY CIRCUIT	JSC-EA 1-1 S	DEVELOP PLAN RELATIVE TO TESTING OF AN APU FOR OVERSPEED CONDITIONS RESULTING FROM GGVM FAILURE. REPORT RESULTS TO THE ORBITER CCB PRIOR TO PROCEEDING WITH IM-PLEMENTATION.	05/22/86 JSC-AE	
			JSC-VA 2-1 S	IMPLEMENT THIS CHANGE IN YOUR PROJECT AND ISSUE APPROPRIATE DIRECTION TO YOUR CONTRACTOR.	05/22/86 JSC-AE	

REPORT NO. 2102-4

S D R I S T A T U S
UNCATEGORIZED OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60065		OMS CROSSFEED LINE LEAKAGE	JSC-VA 1-1 S	DEVELOP PLAN TO ACCOM- PLISH RESOLUTION OF THIS ISSUE WITHIN THE CURRENT PROGRAM REVIEW SCHEDULE. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	05/22/86 JSC-AE	
60066		OMS/RCS AC MOTOR V ALVE MICROSWITCH F AILURES	JSC-VA 1-1 S	PROVIDE CURRENT STATUS, AND IMPACTS, REGARDING PRODUCTION OF REPLACE- MENT AC MOTOR VALVE ACT- UATORS WITH PIND-TESTED SWITCHES. SUBMIT RECOM- MENDATIONS FOR UPGRADING THE ACTUATORS AND DETER- MINE IF ANY VEHICLE RE-WORK IS REQUIRED. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	05/22/86 JSC-AE	

REPORT NO. 2102-4

S D R I   S T A T U S
UNCATEGORIZED OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60066			JSC-VA 2-1 S	ASSESS OTHER VEHICLE APPLICATIONS OF MICRO-SWITCHES TO DETERMINE IF REPLACEMENT IS REQUIRED. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	05/22/86 JSC-AE	
60068		OME BI-PROPELLANT VALVE LEAKAGE	JSC-GA/M 1-1 S	INCLUDE IN CIL/OMI REVIEW THE ASSESSMENT OF KSC POST-LANDING OPERA-TIONS PRIORITIES TO EN-SURE TIMELY PERFORMANCE OF ORBITAL MANEUVERING ENGINE BI-PROPELLANT VALVE PURGE. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	05/22/86 JSC-AE	
60072		INTERNAL REACTANT LEAKAGE WITHIN FUE L CELLS	JSC-VA 1-1 S	DEVELOP PLAN AND ASSESS IMPACTS FOR REDESIGN OF CELL PERFORMANCE MONITOR REPORT RESULTS TO THE SPECIAL LEVEL II PRCB. (SDRB)	05/22/86 JSC-AE	

REPORT NO. 2102-4

S D R I S T A T U S
UNCATEGORIZED OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60073		POTENTIAL FAILURE OF PRSD TANK SUPPO RT STRAPS	JSC-VA 1-1 S	IMPLEMENT TEARDOWN OF SELECTED O2 FLIGHT TANK AND TESTING OF ITS SUPPORT STRAPS. ISSUE APPROPRIATE DIRECTION TO YOUR CONTRACTOR. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	05/22/86 JSC-AE	
			JSC-VA 2-1 S	ASSESS IMPACTS OF ADDI- TION OF INSTRUMENTATION TO PRSD TANKS. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	05/22/86 JSC-AE	
60075 R1		ARS - EXTERNAL LEA KAGE OF EMERGENCY O2 SYSTEM	JSC-GA/M 1-1 S	INCLUDE SDRI #JEC012 IN CIL/FMEA REVIEW.	06/13/86 JSC-EA	

REPORT NO. 2102-4

SDRI STATUS
UNCATEGORIZED OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60076		POTENTIAL LOSS OF ARS EMER O2 TO LAUNCH-ENTRY HELMET	JSC-EA 1-1 S	INVESTIGATE ALL POSSIBLE IMPLEMENTATIONS FOR EXTENDING THE DURATION OF THE CREW EGRESS EMERGENCY AIR SUPPLY. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	05/29/86 JSC-EA	
			JSC-GA/BOC 1-2 S		05/29/86 JSC-EA	
60076 R1		POTENTIAL LOSS OF ARS EMER O2 TO LAUNCH-ENTRY HELMET	JSC-DA 1-1 S	PROVIDE OPERATIONAL ASSESSMENT OF RECOMMENDATION TO FLY WITH SPARE PEAP AND LEH. INCLUDE APPROPRIATE PROCEDURES AND STOWAGE IMPACTS. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD)	06/16/86 JSC-EA	

REPORT NO. 2102-4

S D R I S T A T U S
UNCATEGORIZED OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60077		ARS EXTERNAL LEAKAGE	JSC-VA 1-1 S	ASSESS IMPACTS FOR RESOLVING THIS ISSUE. PROPOSE IMPLEMENTATION SCHEDULE IN ACCORDANCE WITH PRIORITIES OF OTHER SDR ISSUES TO BE IN-CLUDED IN THE NORMAL LEVEL II PRCB PROCESS. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	10/30/86 JSC-EA	
60098		CABIN SMOKE DETECTORS RESET SWITCH	JSC-VA 1-1 S	REVIEW ELECTRICAL REDESIGN OF SMOKE DETECTION AND FIRE SUPPRESSION SYSTEM TO REDUCE FAILURE POTENTIAL REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	06/16/86 JSC-AE	

REPORT NO. 2102-4

S D R I S T A T U S
UNCATEGORIZED OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60098			JSC-VA 2-1 S	REVIEW CORROSION ANOMALIES RELATIVE TO HERMETICALLY SEALED SWITCHES. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	06/16/86 JSC-AE	
60109		OV-102 TPS UPGRADE REQUIRED TO ACHIEVE OPER. LIMITS	JSC-VA 1-1 S	DEVELOP COST/WEIGHT/-SCHEDULE IMPACTS FOR COMPLETION OF MCR 10982 AND REDESIGN/REPLACEMENT OF HSRI TILES ON OV-102 WHICH HAVE A FACTOR OF SAFETY LESS THAN 1.4 AT OPERATIONAL LIMITS. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	12/19/86 JSC-AE	

REPORT.NO. 2102-4

S D R I S T A T U S
UNCATEGORIZED OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60110		REPLACEMENT OF SON IC TESTED TPS	JSC-VA 1-1 S	DEVELOP COST/WEIGHT/ SCHEDULE IMPACTS ASSOC. WITH REPLACEMENT OF ALL LI-900 TILES REQUIRING SONIC VALUES WITH FRCI-12. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	12/19/86 JSC-AE	
60111		STRUCTURE FATIGUE CERTIFICATION COMP LETION	JSC-VA 1-1 S	PERFORM FATIGUE ANALYSIS OF CRITICAL AREAS OF THE ORBITER STRUCTURE. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	12/18/87 JSC-AE	
60112		ENGINEERING ANALYS IS REPORT COMPLETI ON	JSC-VA 1-1 S	COMPLETE EAR'S REQUIRED TO COMPLETE FATIGUE LIFE ASSESSMENT AND CERTIFI-CATION. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	12/17/87 JSC-AE	

REPORT NO. 2102-4

S D R I S T A T U S
UNCATEGORIZED OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60115		CERTIF. OF TPS INTERNAL RE-WATERPROOFING MATERIAL	JSC-VA 1-1 S	PROCEED WITH CERTIFICATION TESTING OF DMES AS A TPS INTERNAL WATER-PROOFING MATERIAL AND REPORT COST IMPACT TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	07/11/86 JSC-AE	
60118		TPS FLIGHT INSTRUMENTATION FOR WTR MISSION CERTIF.	JSC-VA 1-1 S	REVIEW REQUIREMENTS AND PROVIDE RECOMMENDATIONS FOR IMPLEMENTATION OF FINAL TPS INSTRUMENTATION CONFIGURATION OF ALL ORBITERS. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	07/11/86 JSC-AE	
60127		POTENT STAR TRCKR DAMAGE FROM INADVERT SHUTTER OPENING	JSC-VA 1-1 S	COORDINATE APPLICABLE REVIEWS OF THE STAR TRACKER DAMAGE CONCERN AND THE PROPOSED RESOLUTION. PROVIDE RECOMMENDATION TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	06/20/86 JSC-AE	

REPORT NO. 2102-4

S D R I S T A T U S
UNCATEGORIZED OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60128		STAR TRACKER/NAV BASE DAMAGE DURING GROUND HANDLING	JSC-VA 1-1 S	ENSURE THAT THE OMRSD AND OMI PROVIDE SUFFICIENT GUIDANCE AND ADEQUATE QUALITY CONTROL TO PRECLUDE DAMAGE TO THE STAR TRACKER/NAVIGATION BASE DURING GROUND HANDLING.	07/11/86 JSC-AE	
			KSC-GM 2-1 S	REPORT COMPLIANCE WITH EXISTING PROCEDURES REGARDING THE STAR TRACKER/NAVIGATION BASE AND RECOMMENDED CHANGES TO THOSE PROCEDURES TO ENSURE THAT POTENTIAL FOR DAMAGE IS MINIMIZED. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	07/11/86 JSC-AE	

REPORT NO. 2102-4

SDRI STATUS
UNCATEGORIZED OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60130		LAUNCH VEHICLE ASCENT WING PRESSURE DISTRIBUTION	JSC-VA 1-1 S	ASSESS COST/SCHEDULE IMPACTS OF INCORPORATING THE RECOMMENDED FLUTTER-BUFFET DTO'S IN FIRST FLIGHT SOFTWARE AND PRIORITIZE RELATIVE TO OTHER SOFTWARE CHANGE REQUESTS FOR FIRST FLIGHT. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	07/11/86 JSC-AE	
			JSCGA/OASCB 2-1 S	DEVELOP MANPOWER/SCHEDULE/COST AND OTHER IMPACTS ASSOCIATED WITH THIS CHANGE IN CONJUNCTION WITH AN OVERALL AVIONICS SOFTWARE REVIEW RECOMMENDATIONS REGARDING THIS CHANGE WILL BE DEVELOPED BY THE OASCB. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB. (SYSTEM DESIGN REVIEW BOARD).	07/11/86 JSC-AE	
			JSCGA/OASCB 2-2 S		07/11/86 JSC-AE	

REPORT NO. 2102-4

S D R I   S T A T U S
UNCATEGORIZED OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60135		GSE INTERFACE FILTERS IN ORBITER FLUID LINES	JSC-GA/M 1-1 S	RE-REVIEW PRESENT GSE/ORBITER FLUID INTERFACE FILTER REQUIREMENTS VS AS-BUILT CONFIGURATIONS AND PROVIDE ANY ADDITIONAL CONCERNS TO THE DCR.	07/11/86 JSC-NA	
60135 R1		GSE INTERFACE FILTERS IN ORBITER FLUID LINES	JSC-VA 1-1 S	ASSESS IMPACTS AND PROVIDE RECOMMENDATIONS ON THE ADDITION OF FILTERS UPSTREAM OF PURGE ORIFICES FOR BOTH HELIUM AND NITROGEN PURGE SYSTEMS. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	07/25/86 JSC-NA	

REPORT NO. 2102-4

S D R I   S T A T U S
UNCATEGORIZED OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60137		ENHANCED HAZARD ANALYSIS FOR OPERATIONS/SPT ACTIVITIES	JSC-GA/M 1-1 S	WORKING WITH THE KSC SAFETY OFFICE, FORMULATE A PLAN PROPOSING THE RESPONSIBLE ORGANIZATION AND METHOD OF IMPLEMENTING HAZARD ANALYSIS ACTIVITIES AND PROCEDURES FOR MINIMIZING INFLIGHT HAZARDS RESULTING FROM CRITICAL OPERATIONS AND SUPPORT ACTIVITIES (INCLUDE IMPACTS). REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	07/11/86 JSC-NA	
			KSC-NE 1-2 S		07/11/86 JSC-NA	
60145		SSME CONTROLLER POWER	MSFC-SSME 1-1 S	PROVIDE RATIONALE TO THE PROGRAM MANAGER FOR PRESENT USE OF AC POWER RATHER THAN DC POWER FOR THE MAIN ENGINE CONTROLLER. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN BOARD).	06/16/86 JSC-NA	

REPORT NO. 2102-4

S D R I S T A T U S
UNCATEGORIZED OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60145			MSFC-SSME 2-1 S	PROVIDE IMPACTS OF USING DC POWER IN BLOCK 2 MAIN ENGINE CONTROLLER. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	06/16/86 JSC-NA	
			JSC-VA 3-1 S	PROVIDE IMPACTS OF SUPPLYING BLOCK 2 MAIN ENGINE CONTROLLER WITH DC POWER. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	06/16/86 JSC-NA	
60146		LOSS OF ORB WINDSH LD DUE TO THERMAL STRESS/BIRD IMPACT	JSC-VA 2-1 S	IDENTIFY PARTS OF THE VEHICLE, OTHER THAN THE WINDOW, SUSCEPTIBLE TO DAMAGE DUE TO BIRD IMPACTS, INCLUDING EFFECTS ON AERODYNAMICS AND CONTROL. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	06/16/86 JSC-NA	

REPORT NO. 2102-4

S D R I S T A T U S
UNCATEGORIZED OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60146			JSC-EA 2-2 S		06/16/86 JSC-NA	
60147		PRESENCE OF SHATTERABLE GLASS IN THE CREW MODULE	JSC-VA 1-1 S	ASSESS IMPACT OF PROVIDING RECOMMENDED NOMEX GLASS FRAGMENT CONTAINER FOR EACH HEAD UP DISPLAY (HUD) UNIT. INCLUDING STOWAGE REQUIREMENTS. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	06/16/86 JSC-NA	
			JSC-CA 2-1 S	PROVIDE SPECIFIC OPERATIONAL GUIDELINES REGARDING A PROTECTIVE COVER FOR EACH HUD UNIT TO JSC-VA.	06/16/86 JSC-NA	

REPORT NO. 2102-4

S D R I   S T A T U S
UNCATEGORIZED OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60149		HYDROGEN ACCUMULATION IN THE MIDFUSELAGE	JSC-NA 1-1 S	DEFINE OPTIMUM CONCEPT FOR DETECTING HYDROGEN AND/OR REMOVING IT FROM THE ORBITER MIDFUSELAGE DURING DESCENT. PROVIDE RECOMMENDATION TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	06/16/86 JSC-NA	
			JSC-EA 1-2 S		06/16/86 JSC-NA	
60243		CREW COMPARTMENT MODS	JSC-VA 1-1 S	PROVIDE IMPLEMENTATION STATUS AND RESOURCE ISSUES, IF ANY, OF PRESENTED CREW COMPARTMENT MODIFICATIONS. REPORT RESULTS TO SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	08/15/86 JSC-VA	

REPORT NO. 2102-4

SDRI STATUS
UNCATEGORIZED OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60244		CREW CABIN DEBRIS CONCERNS	JSC-VA 1-1 S	PROVIDE IMPLEMENTATION PLAN AND SCHEDULE, INCLUDING DESIGN REVIEW FOR AIR SCRUBBER. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	08/15/86 JSC-VA	
			JSC-VA 2-1 S	PROVIDE IMPLEMENTATION STATUS AND SCHEDULE FOR CREW MODULE DEBRIS/CONTAMINATION RELATED ITEMS. DEVELOP IMPACTS AS REQUIRED. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	08/15/86 JSC-VA	
			JSC-VA 3-1 S	REIDENTIFY AND STATUS PREVIOUS ACTIONS REGARDING CREW MODULE CLEANLINESS DURING PROCESSING AT KSC. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	08/15/86 JSC-VA	

REPORT NO. 2102-4

S D R I   S T A T U S
UNCATEGORIZED OPEN ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60262		VLS SRB HAZARD ANALYSIS STUDIES	JSC-TE 1-1 S	DEFINE SRB HAZARD ANALYSIS STUDIES HAVING BEEN PERFORMED AND IDENTIFY THOSE WHICH REMAIN, INCLUDING SRM, SRB, STEEL & FWC, KSC AND VLS. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	02/15/87 USAF-VLS	
			MSFC-SRB 1-2 S		02/15/87 USAF-VLS	
			JSC-GA/M 1-3 S		02/15/87 USAF-VLS	
			USAF-VLS 1-4 S		02/15/87 USAF-VLS	
			KSC-GM 1-5 S		02/15/87 USAF-VLS	

NATIONAL SPACE TRANSPORTATION SYSTEM

SYSTEM DESIGN REVIEW BOARD

SYSTEM DESIGN REVIEW ISSUES

LEVEL II ACTION ITEMS

CLOSED ACTIONS

EXCEPT RPT 2102-5

S D R I S T A T U S
CATEGORY 1 CLOSED ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60002 R2	1	GO2 FLOW CONTROL VALVE PARTICLE IMPACT EFFECTS	JSC-EA 1-1 A	PROVIDE SCHEDULE AND COST IMPACTS OF PERFORMING PARTICLE IMPACT TEST AT WHITE SANDS ON THE EXISTING DESIGN GO2 FLOW CONTROL VALVES, INCLUDING OUTLET LINES AND THE FLOW MANIFOLD. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). THIS ACTION HAS BEEN DESIGNATED A CATEGORY 1 ITEM.	05/19/86 JSC-AM	
60002 R3	1	GO2 FLOW CONTROL VALVE PARTICLE IMPACT EFFECTS	JSC-EA 2-1 A	PROCEED WITH PARTICLE IMPACT TESTING AT WHITE SANDS ON THE EXISTING DESIGN GO2 FLOW CONTROL VALVES, INCLUDING OUTLET LINES AND THE FLOW MANIFOLD. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1.	06/12/86 JSC-AM	

EXCEPT RPT 2102-5

SDRI STATUS
CATEGORY 1 CLOSED ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60011 R1	1 1	THIRD TURBINE DISCHARGE TEMPERATURE REDLINE SENSOR	KSC-GM 4-1 A	IMPLEMENT IN YOUR PROJECT THE ADDITION OF A THIRD REDLINE SENSOR IN BOTH THE HPFTP AND THE HPOTP. CATEGORY 1	07/11/86 JSC-AM	
	1 1		JSC-GM13 5-1 A	UPDATE THE BARS MKK FILE TO REFLECT ADDITION OF A THIRD REDLINE SENSOR IN BOTH THE HPFTP AND THE HOPTP. CATEGORY 1.	07/11/86 JSC-AM	
60016	1 1	RCS REGULATOR CONTAMINATION	JSC-VA 3-2 A	REVIEW ACTIVITIES ASSOCIATED WITH FERRY FLIGHT INCLUDING PREPARATION, THE ACTUAL FERRY FLIGHT AND POST FERRY ACTIVITIES CONCENTRATING ON POSSIBLE INTRODUCTION OF MOISTURE CONTAMINATION INTO THE RCS REGULATORS. REPORT RESULTS AND RECOMMENDATIONS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	04/21/86 JSC-DA	

EXCEPT RPT 2102-5

S D R I S T A T U S
CATEGORY 1 CLOSED ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60025 R1	 1	GRTLS ET SEPARATIO N JET REQUIREMENTS	JSC-VA 1-1 A	ASSESS THIS ISSUE TO VERIFY THAT A PROBLEM EXISTS. IF IT DOES, PRECISELY DEFINE PROBLEM AND DEVELOP PLAN FOR RESOLVING PROBLEM, ENSU-ING THAT PROPOSED SOLU-TION DOES NOT INTRODUCE OTHER UNDESIRED CONDI-TIONS. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN RE-VIEW BOARD). THIS ACTION HAS BEEN DESIGNATED AS A CATEGORY 1 ITEM.	05/12/86 JSC-DA	
60026 R2	1 1	REVERSE WEIGHT-ON-WHEELS LOGIC	JSC-VA 1-1 A	PROCESS SOFTWARE CHANGE REQUEST 69098F AND 69955 IN OVERALL SOFTWARE REVIEW. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). THIS ACTION IS DESIGNATED CATEGORY 1.	06/22/86 JSC-DA	

EXCEPT RPT 2102-5

S D R I S T A T U S
CATEGORY 1 CLOSED ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60026 R2	1 1		JSC-VA 2-1 A	REVIEW RECOMMENDED HARD-WARE APPROACH FOR RE-SOLVING POTENTIAL FALSE WEIGHT-ON-WHEELS IN-DICATION AS COMPARED TO RECOMMENDED SOFTWARE APPROACH. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1.	06/22/86 JSC-DA	
	1 1		JSC-DA 2-2 A		06/22/86 JSC-DA	
	1 1		JSC-EA 2-3 A		06/22/86 JSC-DA	

EXCEPT RPT 2102-5

S D R I S T A T U S
CATEGORY 1 CLOSED ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60027 R1	1	MDM ANALOG-TO-DIGITAL CONVERSION FAILURE	JSC-VA 2-1 A	DEVELOP A PLAN FOR RESOLVING MDM FAILURES RELATIVE TO CONTROLLERS (RHC'S, SBTC'S & RPTA'S) JSC-VA ISSUE APPROPRIATE DIRECTION TO YOUR CONTRACTOR. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). THIS ACTION HAS BEEN DESIGNATED A CATEGORY 1 ITEM.	05/12/86 JSC-DA	
	1		JSC-EA 2-2 A		05/12/86 JSC-DA	
	1		JSC-DA 2-3 A		05/12/86 JSC-DA	

EXCEPT RPT 2102-5

S D R I   S T A T U S
CATEGORY 1 CLOSED ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60027 R1	1		JSC-VA 3-1 A	SUBMIT SRB RGA CONFIGURATION DEALING WITH RE-CHANNELIZATION AND CONSIDERATIONS OF SRB POWER FAILURE FOR INCLUSION IN AN OVERALL SOFTWARE REVIEW. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). THIS ACTION HAS BEEN DESIGNATED A CATEGORY 1 ITEM.	05/12/86 JSC-DA	
	1		JSC-EA 3-2 A		05/12/86 JSC-DA	
	1		JSC-DA 3-3 A		05/12/86 JSC-DA	
60027 R2	1 1	MDM ANALOG-TO-DIGITAL CONVERSION FAILURE	KSC-GM 3-1 A	IMPLEMENT NECESSARY HARDWARE CHANGES RELATIVE TO SRB RGA RECHANNELIZATION IN YOUR PROJECT. CATEGORY 1.	07/25/86 JSC-DA	

PAGE NO. 7
DATE 08/11/86

EXCEPT RPT 2102-5

SDRI STATUS
CATEGORY 1 CLOSED ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60027 R2	1 1		KSC-GM 3-2 A		07/25/86 JSC-DA	
	1 1		KSC-GM 3-3 A		07/25/86 JSC-DA	
60028 R1	1 1	SSME DUMP/STOW CON CERNS	JSC-VA 1-1 A	IMPLEMENT IN YOUR PRO-JECT SOFTWARE CHANGE RE-QUEST 79584C TO DUMP REMAINING MPS PROPEL-LANTS THROUGH THE SSMES IN THE STOW POSITION. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY I	07/11/86 JSC-DA	

EXCEPT RPT 2102-5

S D R I S T A T U S
CATEGORY 1 CLOSED ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60029 R2	1	APU ISOLATION VALVE CONCERNS	JSC-VA 1-1 A	PROVIDE A SPECIFIC PLAN FOR IMPLEMENTATION OF IMPROVED INSTRUMENTATION INCLUDING CHANNELIZATION AND POSSIBLE ELECTRICAL INTERRUPTION, AND ASSOCIATED IMPACTS. INCLUDE ASSESSMENT OF INCREASING INSTRUMENTATION FOR SINGLE OR REDUNDANT COVERAGE ON BOTH SOLENOIDS AS OPPOSED TO ONE SOLENOID. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1.	07/11/86 JSC-AM	
	1		JSC-EA 1-2 A		07/11/86 JSC-AM	
	1		JSC-DA 1-3 A		07/11/86 JSC-AM	

EXCEPT RPT 2102-5

S D R I S T A T U S
CATEGORY 1 CLOSED ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60029 R3	1	APU ISOLATION VALVE CONCERNS	JSC-GM13 2-1 A	PREPARE AND SUBMIT APPROPRIATE LEVEL I PCR. CATEGORY 1	06/06/86 JSC-AM	
60031 R1	1	ENTRY WITH SINGLE APU	JSC-VA 1-1 A	DEVELOP A PLAN FOR DEFINITION OF OPTIMUM CONFIGURATION OF THE ORBITER TO DEAL WITH SINGLE APU OPERATION UTILIZING EXISTING SIMULATION CAPABILITIES AND FLIGHT EXPERIENCE. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). THIS ACTION HAS BEEN DESIGNATED AS A CATEGORY 1 ITEM.	05/06/86 JSC-AM	
	1		JSC-VA 1-2 A		05/06/86 JSC-AM	

EXCEPT RPT 2102-5

S D R I S T A T U S
CATEGORY 1 CLOSED ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60031 R2	1 1	ENTRY WITH SINGLE APU	JSC-VA 1-1 A	DEVELOP A PLAN FOR DEFINITION OF OPTIMUM CONFIGURATION OF THE ORBITER TO DEAL WITH SINGLE APU OPERATION UTILIZING EXISITING SIMULATION CAPABILITIES AND FLIGHT EXPERIENCE. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1.	07/11/86 JSC-AM	
	1 1		JSC-DA 1-2 A		07/11/86 JSC-AM	
	1 1		JSC-VA 2-1 A	PROVIDE STATUS OF SINGLE APU ENTRY CERTIFICATION, INCLUDING ENVIRONMENTALY INDUCED CONSTRAINTS AND APPLICABLE FLIGHT EXPERIENCE, TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1.	07/11/86 JSC-AM	

PAGE NO. 11
DATE 08/11/86

EXCEPT RPT 2102-5

S D R I S T A T U S
CATEGORY 1 CLOSED ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60031 R4	1 1	ENTRY WITH SINGLE APU	JSC-GM13 1-1 A	PREPARE AND SUBMIT APPROPRIATE LEVEL I PCR.	08/05/86 JSC-AM	
60035 A	1	ORBITER ARRESTING SYSTEM PROCUREMENT	JSC-GM13 1-1 A	PREPARE AND SUBMIT APPROPRIATE PCR FOR LEVEL I APPROVAL OF FUNDING FOR PROCUREMENT AND INSTALLATION OF SIX ORBITER ARRESTING SYSTEMS AND FOR RELATED DEVELOPMENT TESTING. CATEGORY 1.	06/18/86 JSC-TA	
60035 B	1	.ADDITIONAL LANDIN G AIDS FOR AUGMENT ED LANDING SITES	JSC-GM13 1-1 A	PREPARE AND SUBMIT APPROPRIATE PCR FOR LEVEL I APPROVAL OF FUNDING FOR LANDING AIDS AND FACILITIES FOR AUGMENTED LANDING SITES. CATEGORY 1.	06/19/86 JSC-TA	

EXCEPT RPT 2102-5

S D R I S T A T U S
CATEGORY 1 CLOSED ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60035 R1	1	LANDING/DECELERATION SYSTEM CAPABILITY	JSC-TA 4-1 A	DEVELOP OVERALL RUNWAY BARRIER IMPLEMENTATION PLAN, INCLUDING: A. PROCUREMENT PLAN B. DEFINITION OF METHOD FOR OBTAINING LARC SUPPORT (REF PRCBD S33227) REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1.	06/12/86 JSC-AM	
	1		JSC-TA 5-1 A	DEVELOP RUNWAY BARRIER SPECIFICATIONS THAT RESULT IN MINIMUM ORBI- TER DAMAGE (REF PRCBD S33227) REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1.	06/12/86 JSC-AM	
	1		JSC-CA 5-2 A		06/12/86 JSC-AM	
	1		JSC-DA 5-3 A		06/12/86 JSC-AM	

EXCEPT RPT 2102-5

SDRI STATUS
CATEGORY 1 CLOSED ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60035 R-1	1		JSC-EA 5-4 A		06/12/86 JSC-AM	
	1		JSC-VA 5-5 A		06/12/86 JSC-AM	
	1		LARC 5-6 A		06/12/86 JSC-AM	
	1		JSC-TA 6-1 A	DEVELOP PLAN FOR INSTALLATION OF RUNWAY BARRIER (S) AT SELECTED SITES, INCLUDING RUNWAY INSTALLATION LOCATIONS (REF PRCBD S33227). REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1.	06/12/86 JSC-AM	
	1		KSC-NE 6-2 A		06/12/86 JSC-AM	

EXCEPT RPT 2102-5

S D R I S T A T U S
CATEGORY 1 CLOSED ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60040 R1	1 1	LACK OF VIABLE CRW ESCAPE RTE TO SLDWRE LNCH PAD FIRE	JSC-NA 1-1 A	REASSESS LAUNCH PAD ESCAPE CAPABILITIES, INCLUDING THE RECOMMENDED PROTECTION OF THE SIDE HATCH-TO-SLIDEWIRE ROUTE COORDINATE RESULTS WITH SHUTTLE CREW ABORT AND PLANNED EGRESS WORKING GROUP. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1.	07/11/86 JSC-DA	
	1 1		KSC-NE 1-2 A		07/11/86 JSC-DA	
	1 1		JSC-CA 1-3 A		07/11/86 JSC-DA	
	1 1		USAF-VLS 1-4 A		07/11/86 JSC-DA	

EXCEPT RPT 2102-5

S D R I S T A T U S
CATEGORY 1 CLOSED ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60041 A	1 1	CREW ESCAPE CAPABI LITY FROM LIFTOFF THROUGH ROLLOUT	JSC-CA 8-1 A	DEFINE TIME CONSTRAINTS AND DEVELOP SPECIFIC FUNCTIONAL REQUIREMENTS FOR AN EMERGENCY EGRESS SLIDE, ENSURING NON-INT-ERFERENCE WITH NORMAL ORBITER FUNCTIONS. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1.	07/31/86 JSC-GA	
	1 1		JSC-DA 8-2 A		07/31/86 JSC-GA	
	1 1		JSC-SA 8-3 A		07/31/86 JSC-GA	
	1 1		JSC-VA 9-1 A	DEVELOP AN IMPLEMENTA-TION PLAN AND IMPACTS FOR THE EMERGENCY EGRESS SLIDE. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).CATEGORY 1	07/31/86 JSC-GA	

EXCEPT RPT 2102-5

SDRI STATUS
CATEGORY 1 CLOSED ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60047 R2	1 1	INADVERTENT MODE TRANSITION	JSC-VA 2-1 A	SUBMIT APPROPRIATE SOFTWARE CR TO IMPLEMENT A MACH NUMBER CHECK IN MAJOR MODES 304 & 602. CATEGORY 1	07/11/86 JSC-AM	
60069 R1	1 1	COMBUSTION INSTABILITY OF RCS PRIMARY THRUSTERS	JSC-VA 1-1 A	DEVELOP AND CERTIFY A SYSTEM FOR DETECTION OF RCS THRUSTER INSTABILITY OR BURNTHROUGH. CATEGORY 1.	07/11/86 JSC-AE	
60074 R1	1 1	WCS WIRE HARNESS FLAMMABILITY	JSC-VA 1-1 A	IMPLEMENT INSTALLATION OF A MODIFIED WCS WIRE HARNESS CONTAINING NO RAYCHEM WIRING IN YOUR PROJECT AND ISSUE APPROPRIATE DIRECTION TO YOUR CONTRACTOR. CATEGORY 1.	07/11/86 JSC-EA	
	1 1		KSC-GM 2-1 A	IMPLEMENT INSTALLATION OF A MODIFIED WCS WIRE HARNESS CONTAINING NO RAYCHEM WIRING IN YOUR PROJECT. CATEGORY 1.	07/11/86 JSC-EA	

EXCEPT RPT 2102-5

SDRI STATUS
CATEGORY 1 CLOSED ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60074 R1	1 1		KSC-GM 2-2 A		07/11/86 JSC-EA	
	1 1		KSC-GM 2-3 A		07/11/86 JSC-EA	
60074 R2	1 1	WCS WIRE HARNESS F LAMMABILITY	NONE 1-1 A	NO ACTION NO ACTIONEE	07/08/86 JSC-EA	
60089 R1	1 1	IMPROVED TPS AROUN D NOSE CAP	JSC-VA 1-1 A	ASSESS THE TWO PROPOSED REDESIGNS OF THE TPS IN THE ORBITER NOSE AREA AND DEVELOP IMPACTS FOR IMPLEMENTATION OF EACH. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB SYSTEM DESIGN REVIEW BOARD). CATEGORY 1.	07/11/86 JSC-AE	
60089 R2	1 1	IMPROVED TPS AROUN D NOSE CAP	JSC-GM13 2-1 A	PREPARE AND SUBMIT AN APPROPRIATE PCR TO LEVEL I FOR FUNDING APPROVAL.	08/06/86 JSC-AE	

EXCEPT RPT 2102-5

SDRI STATUS
CATEGORY 1 CLOSED ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60090 R1	1 1	WING/ELEVON COVE A REA REDESIGN TO PR ECLUDE PLASMA FLOW	JSC-VA 1-1 A	PROVIDE RECOMMENDATIONS FOR REDESIGN OF THE WING/ELEVON COVE AREA (CURRENTLY BEING WORKED) REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1	07/11/86 JSC-AE	
60090 R2	1 1	WING/ELEVON COVE A REA REDESIGN TO PR ECLUDE PLASMA FLOW	JSC-GM13 1-1 A	PREPARE AND SUBMIT APPROPRIATE LEVEL I PCR.	08/06/86 JSC-AE	
60091 R1	1 1	POSSIBLE CROSS-CON NECTING OF GRND RA CK PIC CONNECTIONS	KSC-NE 1-1 A	DEVELOP PLAN TO PRECLUDE CROSS-CONNECTING THE GROUND PIC RACK OUTPUTS. INCLUDE ALL PROCEDURAL AND HARDWARE (KEYED CONNECTORS) APPROACHES AND RELATED COST/ SCHEDULE IMPACTS. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 1.	07/11/86 JSC-AE	

EXCEPT RPT 2102-5

S D R I S T A T U S
CATEGORY 1 CLOSED ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60091 R1	1 1		USAF-VLS 1-2 A		07/11/86 JSC-AE	
60099	1 1	ATCS-FLASH EVAPORA TOR FREON LEAK	KSC-GM 2-1 A	IMPLEMENT ADDITION OF IMPACT PROTECTION FOR EACH FLASH EVAPORATOR IN YOUR PROJECT. CATEGORY 1	07/21/86 JSC-AE	
	1 1		KSC-GM 2-2 A		07/21/86 JSC-AE	
	1 1		KSC-GM 2-3 A		07/21/86 JSC-AE	
	1 1		JSC-GM13 3-1 A	UPDATE THE BARS MKK FILE TO REFLECT ADDITION OF IMPACT PROTECTION FOR EACH FLASH EVAPORATOR. CATEGORY 1.	07/21/86 JSC-AE	

EXCEPT RPT 2102-5

S D R I   S T A T U S
CATEGORY 1 CLOSED ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60105	1 1	POTENTIAL DAMAGE OF SEPARATION SYSTEM PYRO WIRES	KSC-GM 2-1 A	IMPLEMENT IN YOUR PROJECT, MODIFICATION OF PYRO BLAST CONTAINERS FOR THE ORBITER/ET STRUCTURAL AND UMBILICAL SEPARATION SYSTEMS. CATEGORY 1.	07/11/86 JSC-AE	
	1 1		JSC-GM13 3-1 A	UPDATE THE BARS MKK FILE TO REFLECT MODIFICATION OF PYRO BLAST CONTAINERS FOR THE ORBITER/ET STRUCTURAL AND UMBILICAL SEPARATION SYSTEMS. CATEGORY 1.	07/11/86 JSC-AE	
60106	1 1	UMBILICAL SEPARATION SYSTEM HARDWARE ASSEMBLY	KSC-GM 2-1 A	IMPLEMENT IN YOUR PROJECT, MODIFICATION FOR INSTALLATION VERIFICATION OF UMBILICAL SEPARATION ASSEMBLY CATEGORY 1.	07/11/86 JSC-AE	
	1 1		JSC-GM13 3-1 A	UPDATE THE BARS MKK FILE TO REFLECT MODIFICATION FOR VERIFICATION OF UMBILICAL SEPARATION ASSEMBLY INSTALLATION.	07/11/86 JSC-AE	

PAGE NO. 21
DATE 08/11/86

EXCEPT RPT 2102-5

S D R I S T A T U S
CATEGORY 1 CLOSED ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60107	1	ET AFT UMBILICAL D OOR THERMAL BARRIE R	JSC-VA 1-1 A	REEVALUATE ET AFT UMB- ILICAL DOOR THERMAL BARRIER REPAIR PROCEDU- RES TO IDENTIFY POSSIBLE IMPROVEMENTS. REPORT RECOMMENDATIONS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). THIS ACTION HAS BEEN DESIGNATED CATEGORY 1.	07/11/86 JSC-AE	
60143	1 1	PRESERVATION OF SR B SEGMENT ROUNDNES S DURING GROUND HA	MSFC-SRB 1-1 A	REPORT RESOLUTION OF THIS ISSUE, REGARDING SRB SEGMENT ROUNDNESS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN RE- VIEW BOARD). CATEGORY 1	12/01/86 JSC-NA	

EXCEPT RPT 2102-5

S D R I S T A T U S
CATEGORY 1 CLOSED ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60148	1	SHORTING BTWN ADJ PINS IN BFS FLT CN TRLLR PWR CONNECTR	JSC-VA 1-1 A	PROVIDE CURRENT STATUS OF COMPLIANCE OF BFS, REGARDING CIRCUIT SEPARATION CRITERIA SPECIFIED IN JSC-8080, AND DEVELOP IMPACTS, IF ANY, TO ACHIEVE FULL COMPLIANCE WITH THESE REQUIREMENTS. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). THIS ACTION HAS BEEN DESIGNATED CATEGORY 1.	06/12/86 JSC-NA	
60152	1 1	CERTIFICATION OF TAL ABORT MODES	JSC-VA 1-1 A	PERFORM NECESSARY TEST AND ANALYSIS TO CERTIFY TAL ABORT MODES. CATEGORY 1	07/11/86 JSC-TA	
	1 1		MSFC-ET 1-2 A		07/11/86 JSC-TA	
	1 1		JSC-TA 1-3 A		07/11/86 JSC-TA	

EXCEPT RPT 2102-5

S D R I   S T A T U S
CATEGORY 1 CLOSED ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60153	1 1	CONTINGENCY ABORTS	JSC-CA 1-1 A	PROVIDE OVERALL DEFINITION OF SCOPE OF THE ANALYSES REQUIRED TO DEFINE CONTINGENCY ABORT CAPABILITY TO THE ABORT TEAM. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW). CATEGORY 1	07/11/86 JSC-TA	
	1 1		JSC-DA 1-2 A		07/11/86 JSC-TA	
60182	1 1	AFT FUSELAGE WIRING PROTECTION	JSC-VA 1-1 A	DETERMINE DESIGN SOLUTION TO PROVIDE ADEQUATE PROTECTION FOR WIRE HARNESSES SUSCEPTIBLE TO DAMAGE BY PERSONNEL DURING TURNAROUND ACTIVITY AND PROVIDE IMPACTS. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).CATEGORY 1	07/31/86 KSC-NE	

EXCEPT RPT 2102-5

S D R I S T A T U S
CATEGORY 1 CLOSED ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60182	1 1		KSC-NE 2-1 A	REPORT ALL SPECIFIC INCIDENTS OF WIRE DAMAGE DURING TURNAROUND ACTIVITIES IN ALL ORBITERS INCLUDING LOC-ATION AND EXTENT OF DAMAGE. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).CATEGORY 1	07/31/86 KSC-NE	
	1 1		JSC-VA 3-1 A	PROPOSE SOLUTIONS FOR OTHER AREAS IDENTIFIED BY KSC RELATIVE TO WIRE DAMAGE. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).CATEGORY 1	07/31/86 KSC-NE	
60219	1 1	MPS LO2/LH2 - INST ALL DEBRIS TRAP	JSC-GM13 3-1 A	PREPARE AND SUBMIT APPROPRIATE LEVEL I PCR.	08/06/86 KSC-GM	
60221	1 1	PAYLOAD CHANGEOUT ROOM - ECS UPGRADE	JSC-GM13 1-1 A	PREPARE AN APPROPRIATE PCR FOR SUBMITTAL TO LEVEL I FOR APPROVAL. CATEGORY 1.	08/06/86 KSC-GM	

EXCEPT RPT 2102-5

S D R I S T A T U S
CATEGORY 1 CLOSED ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60239	1 1	POTENTIAL SHOOTING OF THE AC BUSSES	JSC-VA 3-1 A	PROVIDE MODIFICATION HARDWARE AND ENGINEERING TO ACCOMPLISH REPLACEMENT OF 3 AMP FUSES WITH 1/2 AMP FUSES. SUBMIT TO THE LEVEL II PRCB FOR MODIFICATION IMPLEMENTATION IN OV-102. CATEGORY 1.	08/15/86 JSC-VA	
	1 1		JSC-VA 3-2 A		08/15/86 JSC-VA	
	1 1		JSC-VA 3-3 A		08/15/86 JSC-VA	
	1 1		JSC-GM13 4-1 A	UPDATE BARS MKK FILE TO REFLECT REPLACEMENT OF THE NINE 3 AMP FUSES WITH NINE 1/2 AMP FUSES. CATEGORY 1	08/15/86 JSC-VA	

REPORT NO. 2102-6

S D R I S T A T U S
CATEGORY 2 CLOSED ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60035 R1	2	LANDING/DECELERATION SYSTEM CAPABILITY	JSC-VA 11-1 A	PROVIDE DISCUSSION OF POTENTIAL FOR IMPROVING WEARABILITY OF TIRES INCLUDING IMPACTS INVOLVED. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 2.	06/12/86 JSC-AM	
	2		JSC-AE 11-2 A		06/12/86 JSC-AM	
	2		JSC-VA 13-1 A	ASSESS POTENTENTIAL IMPROVEMENTS RESULTING FROM A. LANDING GEAR CONTINGENCY SKID AND ROLL-ON-RIM CAPABILITIES B. REASONABLY IMPLEMENTABLE NOSEWHEEL STRUT EXTENSION. ALSO, IDENTIFY MEASURES REQUIRED TO GET ADDITIONAL UNLOADING PERFORMANCE FROM NLG STRUT EXTENSION REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 2.	07/11/86 JSC-AM	

REPORT NO. 2102-6

S D R I S T A T U S
CATEGORY 2 CLOSED ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60042 R1	1 2	RANGE SAFETY SYSTE M CONCERNS	MSFC-SRB 2-1 A	REDESIGN THE SRB RSS TO PROVIDE A BALANCE BETWEEN SAFETY AND OPER-ATIONAL CONSIDERATIONS. CATEGORY 2.	07/11/86 JSC-AM	
60107	2	ET AFT UMBILICAL D OOR THERMAL BARRIE R	JSC-VA 2-1 A	DEVELOP ALTERNATE CONFI-GURATION FOR RETENTION OF ET AFT UMBILICAL DOOR THERMAL BARRIER WHICH MINIMIZES PROBABLITY OF LAUNCH DAMAGE. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 2.	07/11/86 JSC-AE	
60113	2 2	ORBITER THERMAL WI NDOW UPGRADE	KSC-SE 2-1 A	IMPLEMENT REPLACEMENT OF THE ORBITER WINDOWS (SIDE AND MIDDLE) WITH THICKER GLASS IN YOUR PROJECT. CATEGORY 2.	07/11/86 JSC-AE	

REPORT NO. 2102-6

S D R I S T A T U S
CATEGORY 2 CLOSED ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60113	2 2		JSC-GM13 3-1 A	UPDATE THE BARS MKK FILE TO REFLECT REPLACEMENT OF THE ORBITER WINDOWS (SIDE AND MIDDLE) WITH THICKER GLASS. CATEGORY 2.	07/11/86 JSC-AE	
60155	2 2	GALLEY WIRE HARNES S FLAMMABILITY	KSC-GM 2-1 A	IMPLEMENT THE WRAPPING OF EACH GALLEY UNIT WIRE HARNESS WITH BETA-CLOTH OR EQUIVALENT MATERIAL IN YOUR PROJECT. CATEGORY 2. (OV-104, FLT 3)	07/11/86 JSC-AE	
	2 2		KSC-GM 2-2 A		07/11/86 JSC-AE	
	2 2		KSC-GM 2-3 A		07/11/86 JSC-AE	
	2 2		JSC-GM13 3-1 A	UPDATE THE BARS MKKP REPORT TO REFLECT THE WRAPPING OF EACH GALLEY UNIT WITH BETA-CLOTH OR EQUIVALENT MATERIAL. CATEGORY 2.	07/11/86 JSC-AE	

REPORT NO. 2102-6

S D R I   S T A T U S
CATEGORY 2 CLOSED ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60172	2 2	OPERATIONAL INSTRU MENTATION FOR POGO ASSESSMENT	JSC-TA 2-1 A	ASSURE THAT THE SYSTEMS INTEGRATION CONTRACTOR (SCHEDULE D) HAS BEEN TASKED TO ANALYZE THE POGO FLIGHT DATA ON EVERY FLIGHT. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). CATEGORY 2.	07/25/86 JSC-AE	
60188	2 2	LEAK OF HOT EXHAUS T GAS @ APU EXHAUS T DUCT PURGE CONN	KSC-NE 2-1 A	IMPLEMENT DELETION OF THE EXHAUST DUCT PURGE FITTING IN YOUR PROJECT AND ISSUE APPROPRIATE DIRECTION TO YOUR CONTRACTOR. CATEGORY 2.	07/31/86 KSC-NE	
	2 2		KSC-NE 2-2 A		07/31/86 KSC-NE	

PAGE NO. 1
DATE 08/11/86

REPORT NO. 2102-7

S D R I   S T A T U S
CATEGORY 3 CLOSED ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60027 R1	3	MDM ANALOG-TO-DIGITAL CONVERSION FAILURE	JSC-VA 1-1 A	SELECT SRB RGA CONFIGURATION FOR INCLUSION IN OVERALL SOFTWARE REVIEW. INCLUDE LEVEL II CHANGE REQUEST S40018. JSC-VA, ISSUE APPROPRIATE DIRECTION TO YOUR CONTRACTOR. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). THIS ACTION HAS BEEN DESIGNATED A CATEGORY 3 ITEM.	05/12/86 JSC-DA	
	3		JSC-VA 1-2 A		05/12/86 JSC-DA	
	3		JSC-DA 1-3 A		05/12/86 JSC-DA	

REPORT NO. 2102-8

S D R I S T A T U S
UNCATEGORIZED CLOSED ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60000		REDEFINITION OF SDRI CATEGORIES	NONE 1-1 A	NO ACTION NO ACTIONEE	05/12/86 JSA-GA	
60001		17-INCH UMBILICAL DISCONNECT VALVE REDESIGN	JSC-VA 1-1 A	REVIEW/DEFINE STATUS OF VLV REDESIGN STUDY. (INCLUDE COST/SCHEDULE IMPACTS). REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	04/16/86 JSC-AM	
			JSC-EA 1-2 A		04/16/86 JSC-AM	

REPORT NO. 2102-8

S D R I   S T A T U S
UNCATEGORIZED CLOSED ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60001			JSC-VA 2-1 A	REVIEW PREVIOUS WORK RELATIVE TO PROBLEMS WITH DISCONNECT TIP LOADS AND FLAPPER ANGLE SETTINGS. DEVELOP A POSTITION ON CHANGES IN DISCONNECT PERFORMANCE MARGINS AND SPECIFICA-TIONS THAT WOULD PRE-CLUDE WAIVERS FOR FUTURE FLIGHTS. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	04/16/86 JSC-AM	
			JSC-GA/M 3-1 A	WITH THE ORBITER CON-TRACTOR SAFETY ORGANIZA-TIONS DEVELOP A PLAN TO ADDRESS THE CURRENT SR& QA POSITION REGARDING THE 17-INCH DISCONNECT DESIGN AND FIXES IN THE AREAS OF PROCEDURES WITHOUT THREAT TO FLIGHT SAFETY. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	04/16/86 JSC-AM	

REPORT NO. 2102-8

S D R I S T A T U S
UNCATEGORIZED CLOSED ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60001			JSC-VA 3-2 A		04/16/86 JSC-AM	
60002 R1		GO2 FLOW CONTROL VALVE PARTICLE IMPACT EFFECTS	JSC-EA 1-1 A	PROVIDE SCHEDULE AND COST IMPACTS OF PERFORMING PARTICLE IMPACT TEST AT WHITE SANDS ON THE EXISTING DESIGN GO2 FLOW CONTROL VALVES, INCLUDING OUTLET LINES AND THE FLOW MANIFOLD. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	05/19/86 JSC-AM	
60004		ANTI-SLAM PVLV SNGL POINT FAIL UNDER ZERO-G CONDITIONS	MSFC-SSME 1-1 A	DETERMINE REQUIREMENTS TO SUPPORT CONDUCTING A ZERO G SHUTDOWN TEST. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	04/16/86 JSC-AM	

REPORT NO. 2102-8

S D R I S T A T U S
UNCATEGORIZED CLOSED ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60004			MSFC-SSME 2-1 A	ANALYZE ENGINE SHUTDOWN HARDWARE/PROCEDURES TO DETERMINE IMPROVED METHODS OF DEFENSING AGAINST FAILURES. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	04/16/86 JSC-AM	
			JSC-VA 3-1 A	ANALYZE ORBITER HARDWARE /PROCEDURES TO DETERMINE IMPROVED METHODS OF DEFENSING AGAINST SSME SHUTDOWN FAILURES. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	04/16/86 JSC-AM	
			JSC-TE 4-1 A	WITH THE PSIG, ASSESS REDUNDANCY ISSUE/SINGLE POINT FAILURES IN ALL ELEMENTS OF THE SHUTDOWN SYSTEM. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	04/16/86 JSC-AM	

REPORT NO. 2102-8

S D R I S T A T U S
UNCATEGORIZED CLOSED ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60005		GSE SCREEN FOR PROPELLANT FILL/DRAIN SYSTEM INLETS	KSC-SE 1-1 A	PRESENT TO PSIG CURRENT STATUS OF OPTIONS BEING STUDIED CONCERNING PROV. OF A GSE SCREEN ON THE H2 SIDE FOR BOTH KSC AND VLS.	04/16/86 JSC-AM	
			JSC-TE 2-1 A	ASSESS KSC-SE GSE SCREEN RECOMMENDATION AND REVIEW DESIGN/CERTIFICATION REQUIREMENTS. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	04/16/86 JSC-AM	
60006		ET ULLAGE PRESSURE TRANSDUCER STICTION PROBLEMS	MSFC-ET 1-1 A	PROVIDE DETAILED PLAN, INCLUDING SCHEDULE/COST IMPACTS, FOR DEVELOPMENT OF THE ALTERNATE TRANSDUCER. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	04/16/86 JSC-AM	
			JSC-TE 1-2 A		04/16/86	

REPORT NO. 2102-8

S D R I S T A T U S
UNCATEGORIZED CLOSED ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60006			JSC-TE 5-1 A	WITH THE PSIG, EXAMINE FEASIBILITY OF SWITCHING IN-FLIGHT TO AN ALTERNATE TRANSDUCER VIA GROUND CONTROL COMMAND BASED ON CONSOLE DATA AS A VIABLE ALTERNATIVE. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). SDRI #SB0006	04/16/86 JSC-AM	
			JSC-VA 5-2 A		04/16/86 JSC-AM	
			MSFC-ET 5-3 A		04/16/86 JSC-AM	
60006 R1		ET ULLAGE PRESSURE TRANSDUCER STICTION PROBLEMS	JSC-TE 1-1 A	RE-EVALUATE FLIGHT RULES AND PROCEDURES FOR LH2 TANK PRESSURE LOW LIMIT ALARM SETTING. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	05/29/86 JSC-AM	

REPORT NO. 2102-8

S D R I   S T A T U S
UNCATEGORIZED CLOSED ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60006 R1			JSC-AM 1-2 A		05/29/86 JSC-AM	
60008		SSME PERFORMANCE DATA CONFIDENCE	JSC-DA 1-1 A	DEVELOP RECOMMENDATION OF APPROPRIATE TESTS TO ASSURE HIGHEST FIDELITY LEVEL OF DATA SUBMITTED. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	04/16/86 JSC-AM	
			JSC-TA 1-2 A		04/16/86 JSC-AM	
			MSFC-SSME 1-3 A		04/16/86 JSC-AM	

REPORT NO. 2102-8

S D R I S T A T U S
UNCATEGORIZED CLOSED ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60008 R1		SSME PERFORMANCE DATA CONFIDENCE	MSFC-SSME 1-1 A	PROVIDE BUDGET & ENGINE TEST PLANNING IMPACTS TO OBTAIN ENHANCED SSME OFF NOMINAL OPERATION PERF. DATA FROM HYDRAULIC LOCK UP & CHAMBER PRESSURE PC SENSOR SHIFT TESTING. THE RESULTING OFF-NOMINAL PERFORMANCE DATA IS USED TO UPDATE MISSION CONTROL ABORT REGION DETERMINATOR (ARD). REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	06/26/86 JSC-AM	
			MSFC-SSME 2-1 A	VERIFV VALIDITV OF CURRENTLY AVAILABLE OFF-NOMINAL OPERATIONS DATA PENDING RECEIPT OF NEW TEST DATA. ALSO PROVIDE REVISION OF CURRENT DATA AS NEEDED, TO REFLECT PHASE II ENGINE OPERATION. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	06/26/86 JSC-AM	

REPORT NO. 2102-8

S D R I   S T A T U S
UNCATEGORIZED CLOSED ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60009		SSME REDLINE VERIFICATION	MSFC-SSME 1-1 A	RE-ASSESS EXISTING REDLINES & THEIR DERIVATION WITH RESPECT TO THIS SDRI. REPORT RESULTS AND PROVIDE RECOMMENDATIONS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	05/01/86 JSC-AM	
			JSC-DA 1-2 A		05/01/86 JSC-AM	
			JSC-EA 1-3 A		05/01/86 JSC-AM	
60011		THIRD TURBINE DISCHARGE TEMPERATURE REDLINE SENSOR	MSFC-SSME 1-1 A	ASSESS IMPACTS OF INCORPORATING A THIRD SENSOR IN BOTH THE HIGH PRESSURE FUEL AND OXIDIZER TURBOPUMPS. REPORT RESULTS AND PROVIDE RECOMMENDATION TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	05/01/86 JSC-AM	

64-548 O—86——18

REPORT NO. 2102-B

SDRI STATUS
UNCATEGORIZED CLOSED ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60011			JSC-DA 2-1 A	DETERMINE BEST IMPLEMENTATION INCLUDING DETAILED DOWNLIST CHANGES. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	05/01/86 JSC-AM	
			JSC-VA 2-2 A		05/01/86 JSC-AM	
			JSCGA/OASCB 3-1 A	DEVELOP MANPOWER/SCHEDULE/COST AND OTHER IMPACTS ASSOCIATED WITH THIS CHANGE IN CONJUNCTION WITH AN OVERALL AVIONICES SOFTWARE REVIEW. RECOMMENDATIONS REGARDING THIS CHANGE WILL BE DEVELOPED BY THE OASCB. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	05/01/86 JSC-AM	
			JSC-VA 3-2 A		05/01/86 JSC-AM	

REPORT NO. 2102-8

S D R I   S T A T U S
UNCATEGORIZED CLOSED ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60012		SRB NOZZLE EROSION	JSC-GA/M 1-1 A	INCLUDE SDRI #SB0012 IN CIL/FMEA REVIEW.	05/01/86 JSC-AM	
60014		REDUNDANCY OF SSME SHUTDOWN PUSHBUTTON CONTACTS	JSC-DA 1-1 A	REASSESS FAILURES WHICH CAN CAUSE VEHICLE CONTROL PROBLEMS DUE TO INCORRECT MODING IN THE EVENT OF SSME SHUTDOWN. CONSIDER THE LEVEL OF REDUNDANCY BEING REQUESTED AS COMPARED TO EXISTING LEVELS OF REDUNDANCY IN APPLICATIONS OF SIMILAR CRITICALITY. PROVIDE RESULTS AND RECOMMENDATIONS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD), IF REQUIRED.	05/01/86 JSC-AM	

REPORT NO. 2102-8

S D R I   S T A T U S
UNCATEGORIZED CLOSED ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60015 R1		CONTAINMENT SHIELD FOR SSME	JSC-VA 1-1 A	PROVIDE TO JSC-CB, ORBITER COMPARTMENT VENTING TIME HISTORIES AND RESULTING PRESSURE DIFFERENTIALS ON EACH PRIMARY STRUCTURAL ELEMENT, AS APPLICABLE TO POSSIBLE DEVELOPMENT OF DESIGN CRITERIA FOR MINIMIZING DAMAGE FROM OVERPRESSURE DUE TO UNCONTROLLED SSME FAILURE.	05/28/86 JSC-AM	
60016		RCS REGULATOR CONTAMINATION	JSC-EA 1-1 A	CONDUCT A THOROUGH INVESTIGATION OF REGULATORS KNOWN TO HAVE FAILED THROUGHOUT THE PROGRAM. SPECIFICALLY INCLUDE ANALYSIS OF EACH FAILED ARTICLE'S USAGE AND ENVIRONMENTAL EXPOSURE UP TO THE TIME OF FAILURE. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD.	04/21/86 JSC-DA	

REPORT NO. 2102-8

S D R I   S T A T U S
UNCATEGORIZED CLOSED ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60016			JSC-VA 1-2 A		04/21/86	
			JSC-VA 2-1 A	REVIEW IMPACTS OF IN- CREASING THE PROPELLANT TANK PRESSURE SAMPLE RATE DURING REGULATOR CHECK OUT IN OPS 1 AND 9. REPORT RESULTS AND PROVIDE RECOMMENDATIONS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	04/21/86 JSC-DA	
			KSC-SM 3-1 A	REVIEW ACTIVITIES ASSOCIATED WITH FERRY FLIGHT INCLUDING PREPAR- ATION, THE ACTUAL FERRY FLIGHT AND POST FERRY ACTIVITIES CONCENTRATING ON POSSIBLE INTRODUCTION OF MOISTURE CONTAMINA- TION INTO THE RCS REGU- LATORS. REPORT RESULTS AND RECOMMENDATIONS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	04/21/86 JSC-DA	

REPORT NO. 2102-8

S D R I   S T A T U S
UNCATEGORIZED CLOSED ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60016			KSC-SM 4-1 A	REVIEW GSE AND PROCEDURE FOR ALL POSSIBLE SOURCES OF CONTAMINATION. COMPARE RESULTS WITH WSTF AVAILABLE DATA. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB SYSTEM DESIGN REVIEW BOARD).	04/21/86 JSC-DA	
			JSC-VA 5-1 A	REVIEW DUAL REGULATOR FAILURE INCIDENT ON APOLLO 16 FOR POSSIBLE COMMON FACTORS WITH RECENT RCS REGULATOR FAILURES. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	04/21/86 JSC-DA	
60016 R2	1	RCS REGULATOR CONT AMINATION	NONE 1-1 A	NO ACTION NO ACTIONEE	05/12/86	

REPORT NO. 2102-8

S D R I   S T A T U S
UNCATEGORIZED CLOSED ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60017		ADD RCS PROPELLANT OVER PRESSURIZATION TO OPS 1,3 & 6	JSC-DA 1-1 A	SUBMIT APPROPRIATE CHANGE REQUEST PROVIDING OVERPRESS PROTECTION IN OPS 1, 3 AND 6 TO OASCB. JSC-VA-ISSUE APPROPRIATE ACTION TO YOUR CONTRACTOR. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	05/15/86 JSC-DA	
			JSC-EA 1-2 A		05/15/86 JSC-DA	
			JSC-VA 1-3 A		05/15/86 JSC-DA	
60018		NO YAW JET MODE UPGRADE/CERTIFICATION	JSC-VA 1-1 A	IMPLEMENT CR 79616, NO YAW JET DOWNMODE,PENDING FINAL OASCB APPROVAL. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	05/15/86 JSC-DA	

REPORT NO. 2102-B

S D R I S T A T U S
UNCATEGORIZED CLOSED ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60018			JSCGA/OASCB 2-1 A	DEVELOP MANPOWER/SCHEDULE/COST AND OTHER IMPACTS ASSOCIATED WITH THIS CHANGE IN CONJUNCTION WITH AN OVERALL AVIONICS SOFTWARE REVIEW. RECOMMENDATIONS REGARDING THIS CHANGE WILL BE DEVELOPED BY THE OASCB. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	05/15/86	
			JSC-VA 2-2 A		05/15/86	
60020		OMS/RCS AC MTR VLV BELLOWS LEAKAGE/VAPOR DETONATION	JSC-VA 2-1 A	PROVIDE SCHEDULE FOR RESPONDING TO ALL ACTION ASSIGNED BY SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD) TO THE SECRETARY OF THE LEVEL II PRCB.	04/21/86	

REPORT NO. 2102-B

SDRI STATUS
UNCATEGORIZED CLOSED ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60021		SCR 59126H RCS CROSSFEED MCA OPTIMIZATION (SMART INTC)	JSC-DA 1-1 A	PROVIDE LIST OF ORGANIZATION REVIEWING SOFTWARE CHANGE REQUEST 5912H TO THE LEVEL II PRCB CHAIRMAN.	04/21/86	
			JSCGA/OASCB 2-1 A	DEVELOP MANPOWER/SCHEDULE/COST AND OTHER IMPACTS ASSOCIATED WITH THIS CHANGE IN CONJUNCTION WITH AN OVERALL AVIONICS SOFTWRAE REVIEW. RECOMMENDATIONS REGARDING THIS CHANGE WILL BE DEVELOPED BY THE OASCB. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	04/21/86 JSC-DA	
			JSC-VA 2-2 A		04/21/86 JSC-DA	

REPORT NO. 2102-8

S D R I   S T A T U S
UNCATEGORIZED CLOSED ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60023		INSTR. PANEL REACH AND VISIBILITY DURING ASCENT	JSC-VA 1-1 A	PROCESS SOFTWARE CHANGE REQUEST 79702C IN OVER-ALL SOFTWARE REVIEW. CONSIDER THIS CHANGE FOR EFFECTIVITY IN ASCENT, ON-ORBIT, AND ENTRY MODES. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	05/06/86 JSC-DA	
60024		ADD PFS SPEC 23 (RCS MANAGEMENT) TO OPS 1/6	JSC-VA 1-1 A	PROCESS SOFTWARE CHANGE REQUEST 79592B IN OVER-ALL SOFTWARE REVIEW. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB SYSTEM DESIGN REVIEW BOARD).	05/06/86 JSC-DA	

REPORT NO. 2102-8

S D R I S T A T U S
UNCATEGORIZED CLOSED ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60025		GRTLS ET SEPARATION JET REQUIREMENTS	JSC-VA 1-1 A	ASSESS THIS ISSUE TO VERIFY THAT A PROBLEM EXISTS. IF IT DOES, PRECISELY DEFINE PROBLEM AND DEVELOP PLAN FOR RESOLVING PROBLEM, ENSURING THAT PROPOSED SOLUTION DOES NOT INTRODUCE OTHER UNDESIRED CONDITIONS. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	04/24/86	
			JSC-EA 1-2 A		04/24/86	
			JSC-TE 2-1 A	ISSUE APPROPRIATE DIRECTION TO YOUR CONTRACTOR TO SUPPORT ACTION ITEMS JSC-VA(1-1) AND JSC-EA (1-2).	04/24/86 JSC-DA	

REPORT NO. 2102-8

S D R I S T A T U S
UNCATEGORIZED CLOSED ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60025 R1		GRTLS ET SEPARATION JET REQUIREMENTS	JSC-EA 1-2 A	ASSESS THIS ISSUE TO VERIFY THAT A PROBLEM EXISTS. IF IT DOES, PRECISELY DEFINE PROBLEM AND DEVELOP PLAN FOR RESOLVING PROBLEM, ENSURING THAT PROPOSED SOLUTION DOES NOT INTRODUCE OTHER UNDESIRED CONDITIONS. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD). THIS ACTION HAS BEEN DESIGNATED AS A CATEGORY 1 ITEM.	05/12/86 JSC-DA	
			JSC-EA 2-1 A	REVIEW AERO DATA BASE TO EVALUATE EXPANSION CAPABILITY REGARDING GRLTS ET-SEP CAPABILITY. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	05/12/86 JSC-DA	

REPORT NO. 2102-8

SDRI STATUS
UNCATEGORIZED CLOSED ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60026	1	REVERSE WEIGHT-ON-WHEELS LOGIC	JSC-VA 1-1 A	PROCESS SOFTWARE CHANGE REQUEST 69098 IN OVERALL SOFTWARE REVIEW. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	05/06/86	
	1		JSCGA/OASCB 2-1 A	DEVELOP MANPOWER/SCHEDULE/COST AND OTHER IMPACTS ASSOCIATED WITH THIS CHANGE IN CONJUNCTION WITH AN OVERALL AVIONICS SOFTWARE REVIEW. RECOMMENDATIONS REGARDING THIS CHANGE WILL BE DEVELOPED BY THE OASCB. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	05/06/86 JSC-DA	
	1		JSC-VA 2-2 A		05/06/86 JSC-DA	
60026 R1	1	REVERSE WEIGHT-ON-WHEELS LOGIC	NONE 1-1 A	NO ACTION NO ACTIONEE	05/12/86	

REPORT NO. 2102-8

S D R I   S T A T U S
UNCATEGORIZED CLOSED ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60027		MDM ANALOG-TO-DIGITAL CONVERSION FAILURE	JSC-VA 1-1 A	SELECT SRB RGA CONFIGURATION, INCLUDING RECHANNELIZATION, FOR INCLUSION IN OVERALL SOFTWARE REVIEW. INCLUDE LEVEL II CHANGE REQUEST S40018. JSC-VA ISSUE APPROPRIATE DIRECTION TO YOUR CONTRACTOR. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	05/06/86	
			JSC-ÈA 1-2 A		05/06/86	
			JSC-DA 1-3 A		05/06/86	

REPORT NO. 2102-8

SDRI STATUS
UNCATEGORIZED CLOSED ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60027			JSC-VA 2-1 A	DEVELOP A PLAN FOR RESOLVING MDM FAILURES RELATIVE TO CONTROLLERS (RHC'S, SBTC'S & RPTA'S) JSC-VA ISSUE APPROPRIATE DIRECTION TO YOUR CONTRACTOR. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	05/06/86	
			JSC-EA 2-2 A		04/24/86	
			JSC-DA 2-3 A		04/24/86	

REPORT NO. 2102-8

S D R I   S T A T U S
UNCATEGORIZED CLOSED ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60027			JSCGA/OASCB 3-1 A	DEVELOP MANPOWER/SCHEDULE/COST AND OTHER IMPACTS ASSOCIATED WITH THIS CHANGE IN CONJUNCTION WITH AN OVERALL AVIONICS SOFTWARE REVIEW. RECOMMENDATIONS REGARDING THIS CHANGE WILL BE DEVELOPED BY THE OASCB. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	04/24/86	
			JSC-VA 3-2 A		04/24/86	
60027 R2	1	MDM ANALOG-TO-DIGITAL CONVERSION FAILURE	JSC-GM13 4-1 A	UPDATE THE BARS MKKP REPORT TO REFLECT HARDWARE CHANGES RELATIVE TO SRB RGA RECHANNELIZATION	07/25/86 JSC-DA	

PAGE NO. 25
DATE 08/11/86

REPORT NO. 2102-8

S D R I   S T A T U S
UNCATEGORIZED CLOSED ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60028		SSME DUMP/STOW CON CERNS	JSC-VA 1-1 A	WORK PROPOSED SOLUTION THROUGH OVERALL SOFTWARE REVIEW. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN RE- VIEW BOARD).	05/06/86	
			JSC-EA 1-2 A		05/06/86	
			JSC-DA 1-3 A		05/06/86	
			JSCGA/OASCB 2-1 A	DEVELOP MANPOWER/SCHED- ULE/COST AND OTHER IMPA- CTS ASSOCIATED WITH THIS CHANGE IN CONJUNCTION WITH AN OVERALL AVIONICS SOFTWARE REVIEW. RECOMM- ENDATIONS REGARDING THIS CHANGE WILL BE DEVELOPED BY THE OASCB. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	05/06/86	

64-548 O—86——19

REPORT NO. 2102-8

S D R I   S T A T U S
UNCATEGORIZED CLOSED ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60028			JSC-VA 2-2 A		05/06/86	
60029		APU ISOLATION VALVE CONCERNS	JSC-VA 1-1 A	PROVIDE A SPECIFIC PLAN FOR IMPLEMENTATION OF IMPROVED INSTRUMENTATION INCLUDING CHANNELIZATION AND ASSOCIATED IMPACTS. INCLUDE ASSESSMENT OF INCREASING INSTRUMENTATION FOR SINGLE OR REDUNDANT COVERAGE ON BOTH SOLENOIDS AS OPPOSED TO ONE SOLENOID. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	04/24/86 JSC-AM	
			JSC-EA 1-2 A		04/24/86 JSC-AM	
			JSC-DA 1-3 A		04/24/86 JSC-AM	

REPORT NO. 2102-8

S D R I S T A T U S
UNCATEGORIZED CLOSED ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60029			JSC-VA 2-1 A	DEVELOP AN OVERALL PLAN, INCLUDING SCHEDULE, FOR REDESIGN OF THE ISOLA-TION VALVE TO REDUCE POTENTIAL OF HYDRAZINE IGNITION. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN RE-VIEW BOARD).	04/24/86 JSC-AM	
			JSC-DA 2-2 A		04/24/86 JSC-AM	
			JSC-EA 2-3 A		04/24/86 JSC-AM	
60029 R1		APU ISOLATION VALVE CONCERNS	JSC-VA 1-1 A	INCLUDE IN THE PLAN FOR IMPROVED INSTRUMENTATION CONSIDERATIONS OF POSS-IBLE ELECTRICAL INTERR-UPTION (REF. ACTION (1-1) OF PRCBD S60029). REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	05/22/86 JSC-AM	

REPORT NO. 2102-8

S D R I   S T A T U S
UNCATEGORIZED CLOSED ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60031		ENTRY WITH SINGLE APU	JSC-VA 1-1 A	DEVELOP A PLAN FOR DEFINITION OF OPTIMUM CONFIGURATION OF THE ORBITER TO DEAL WITH SINGLE APU OPERATION UTILIZING EXISTING SIMU-LATION CAPABILIITES AND FLIGHT EXPERIENCE. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	05/06/86	
			JSC-DA 1-2 A		05/06/86	

REPORT NO. 2102-8

SDRI STATUS
UNCATEGORIZED CLOSED ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60032		APU AUTO SHUTDOWN INHIBIT FUNCTION	JSC-VA 1-1 A	DEVELOP A PLAN, INCLUDING IMPACTS, DETAILING HARDWARE MODIFICATION REQUIRED FOR PROVIDING A SEPARATE AUTO SHUTDOWN ENABLE/INHIBIT SWITCH FOR EACH APU. INCLUDE CONSIDERATIONS OF CREW REACH AND VISIBILITY. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	05/06/86 JSC-AM	
			JSC-DA 1-2 A		05/06/86 JSC-AM	
			JSC-EA 1-3 A		05/06/86 JSC-AM	
60032 R1		APU AUTO SHUTDOWN INHIBIT FUNCTION	KSC-GM 2-1 A	IMPLEMENT INSTALLATION OF A SEPARATE APU SHUTDOWN INHIBIT SWITCH FOR EACH APU.	08/08/86 JSC-AM	

REPORT NO. 2102-8

S D R I S T A T U S
UNCATEGORIZED CLOSED ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60032 R1			KSC-GM 2-2 A		08/08/86 JSC-AM	
			KSC-GM 2-3 A		08/08/86 JSC-AM	
60033		ENTRY WITH PAYLOAD BAY DOOR LATCHES O UT	JSC-VA 1-1 A	RE-EVALUATE CENTERLINE LATCH ISSUE IN THE OVERALL CIL ITEMS REVEIW. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	06/06/86 JSC-AM	
60034		UNCOMMANDED BRAKE PRESSURE	JSC-VA 2-1 A	REVIEW SODB AND UPDATING PROCEDURES/PROCESSES TO ENSURE THAT IT CONTAINS CURRENT, ACCURATE, AND VALIDATED DATA. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	05/06/86 JSC-AM	
			JSC-EA 2-2 A		05/06/86 JSC-AM	

REPORT NO. 2102-8

S D R I   S T A T U S
UNCATEGORIZED CLOSED ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60034			JSC-DA 2-3 A		05/06/86 JSC-AM	
60035		LANDING/DECELERATION SYSTEM CAPABILITY	JSC-TA 10-1 A	IDENTIFY ALL RUNWAYS INTENDED TO BE USED FOR INTACT ABORTS AND DETERMINE COST AND SCHEDULE IMPACTS OF PROVIDING FULL LANDING AIDS AT EACH. (REF LEVEL II CR S33496). REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	05/01/86 JSC-AM	
			JSC-VA 11-1 A	REPORT STATUS/RESULTS OF CURRENT KSC RUNWAY SURFACE EVALUATION AND DETERMINE ESTIMATED TIME OF COMPLETION OF ALL STUDY ACTIVITY. INCLUDE COST & SCHEDULE IMPACTS OF IMPLEMENTING RECOMMENDED MODIFICATIONS. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	05/08/86	

REPORT NO. 2102-8

S D R I S T A T U S
UNCATEGORIZED CLOSED ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60035			JSC-AE 11-2 A		05/08/86	
			KSC-SE 11-3 A		05/08/86	
			LARC 11-4 A		05/08/86	
			JSC-VA 12-1 A	PROVIDE DISCUSSION OF POTENTIAL FOR IMPROVING, WEARABILITY OF TIRES INCLUDING IMPACTS INVOLVED. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	05/08/86	
			JSC-AE 12-2 A		05/08/86	

REPORT NO. 2102-8

S D R I S T A T U S
UNCATEGORIZED CLOSED ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60035			JSC-VA 13-1 A	DEVELOP PROPOSAL FOR RE-INITIATION OF TIRE PRESSURE MONITOR INCLUDING RECOMMENDED INSTRUMENTATION APPROACH (DIRECT PRESSURE SENSOR VS INDIRECT STRUCTURAL SENSOR). REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	05/08/86	
			JSC-VA 14-1 A	ASSESS POTENTIAL IMPROVEMENTS RESULTING FROM A. LANDING GEAR CONTINGENCY SKID AND ROLL-ON-RIM CAPABILITIES. B. RESONABLY IMPLEMENTABLE NOSEWHEEL STRUT EXTENSION. ALSO, IDENTIFY MEASURES REQUIRED TO GET ADDITIONAL UNLOADING PERFORMANCE FORM NLG STRUT EXTENSION. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	05/08/86	

PAGE NO. 34
DATE 08/11/86

REPORT NO. 2102-B

S D R I   S T A T U S
UNCATEGORIZED CLOSED ACTIONS

PCIN. NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60035			JSC-VA 17-1 A	ISSUE APPROPRIATE DIRECTION TO YOUR CONTRACTOR REGARDING ACTION ITEMS JSC-VA (12-1) AND JSC-VA (15-1)	05/08/86 JSC-AM	
			JSC-VA 17-2 A		05/08/86 JSC-AM	
			JSC-VA 2-1 A	DETERMINE SCHEDULE/COST IMPACTS FOR IMMEDIATE FULL IMPLEMENTATION OF THE CURRENT CARBON BRAKE DEVELOPMENT PROGRAM. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	04/17/86	
			JSC-TA 3-1 A	DEVELOP RUNWAY BARRIER DESIGN SPECIFICATIONS THAT RESULT IN MINUMUM ORBITER DAMAGE (REF PRCBD S33227). REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	05/01/86	

REPORT NO. 2102-8

S D R I S T A T U S
UNCATEGORIZED CLOSED ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60035			JSC-TA 4-1 A	DEVELOP RUNWAY BARRIER DESIGN SPECIFICATIONS THAT RESULT IN MINIMUM ORBITER DAMAGE (REF PRCBD S33227). REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	05/01/86	
			JSC-CA 4-2 A		05/01/86	
			JSC-DA 4-3 A		05/01/86	
			JSC-EA 4-4 A		05/01/86	
			JSC-VA 4-5 A		05/01/86	
			LARC 4-6 A		05/01/86	

REPORT NO. 2102-8

S D R I S T A T U S
UNCATEGORIZED CLOSED ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60035			JSC-TA 5-1 A	DEVELOP PLAN FOR INSTALLATION OF RUNWAY BARRIER(S) AT SELECTED SITES, INCLUDING RUNWAY INSTALLATION LOCATIONS (REF PRCBD S33227). REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	05/01/86	
			KSC-SE 5-2 A		05/01/86	
			JSC-VA 6-1 A	INVESTIGATE APPROPRIATE ELEVON POSITIONING DURING ROLLOUT, INCLUDING BOTH ELEVON UP AND DOWN POSITIONS, AND EFFECTS ON TIRES AND BRAKES, INCLUDING THE NLG. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	05/08/86	

PAGE NO. 37
DATE 08/11/86

REPORT NO. 2102-B

S D R I S T A T U S
UNCATEGORIZED CLOSED ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60035			JSC-VA 7-1 A	DEVELOP A PROPOSAL, INCLUDING IMPACTS, FOR FO/FS NOSEWHEEL STEERING UPGRADE IN ALL AREAS EXCEPT HYDRAULIC. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	05/08/86	
			JSC-VA 8-1 A	DEVELOP A PROPOSAL, INCLUDING IMPACTS, FOR IMPLEMENTING FO/FS NOSEWHEEL STEERING WITH A REDUNDANT HYDRAULIC SYSTEM. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	05/08/86	

REPORT NO. 2102-8

S D R I S T A T U S
UNCATEGORIZED CLOSED ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60036		LOSS OF WATER REMO VAL CAPABILITY FOR FUEL CELLS	JSC-VA 1-1 A	DEVELOP A CONCEPT TO SEPARATE THE RELIEF WATER FLOW FROM THE THREE FUEL CELLS INTO MULTIPLE FLOW PATHS WHICH DO NOT FLOW THROUGH A SINGLE WATER RELIEF PANEL. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	05/05/86 JSC-AM	
			JSC-DA 2-1 A	PROVIDE TO JSC-VA OPER-ATIONAL GROUND RULES TO BE UTILIZED IN THE DESIGN FOR SEPARATION OF THE FUEL CELL WATER RELIEF LINES INTO FLOW PATHS WHICH DO NOT FLOW THROUGH A SINGLE WATER RELIEF PANEL.	05/05/86	
60038		FUEL CELL INSTRUME NTATION RECHANNELI ZATION	KSC-SM 2-1 A	IMPLEMENT RECHANNELIZA-TION OF FUEL CELL INSTRUMENTATION IN YOUR PROJECT	05/05/86 JSC-AM	

REPORT NO. 2102-8

S D R I S T A T U S
UNCATEGORIZED CLOSED ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60038			KSC-SM 2-2 A		05/05/86 JSC-AM	
			KSC-SM 2-3 A		05/05/86 JSC-AM	
60039		EMRGNCY EGRESS ESC PNL NO OPN UNDR PO ST LNDNG PRESS DIF	JSC-VA 1-1 A	PROVIDE PLAN FOR IMPLE- MENTATION IN ACCORDANCE WITH RECOMMENDATIONS GIVEN TO THE SYSTEM DE- SIGN REVIEW BOARD OF APRIL 7, 1986, AND IDEN- TIFY RELATED COST/SCHED- ULE IMPACTS. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	05/05/86	

REPORT NO. 2102-8

S D R I S T A T U S
UNCATEGORIZED CLOSED ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60040		LACK OF VIABLE CREW ESCAPE ROUTE TO THE SLIDEWIRE	JSC-NA 1-1 A	REASSESS LAUNCH PAD ESCAPE CAPABILITIES, INCLUDING THE RECOMMENDED PROTECTION OF THE SIDE HATCH-TO-SLIDEWIRE ROUTE, REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	05/05/86 JSC-DA	
			KSC-SE 1-2 A		05/05/86 JSC-DA	
			JSC-CA 1-3 A		05/05/86 JSC-DA	
			USAF-VLS 1-4 A		05/05/86 JSC-DA	

REPORT NO. 2102-8

S D R I S T A T U S
UNCATEGORIZED CLOSED ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60041		CREW ESCAPE CAPABI LITY FROM LIFTOFF THRU LNDNG ROLLOUT	JSC-GA 1-1 A	DETERMINE APPROPRIATE METHOD OF PROCEEDING WITH A COMPREHENSIVE ENGINEERING STUDY OF ALL OPTIONS/TECHNOLOGIES TO DETERMINE MOST OPTIMUM CREW ESCAPE SYSTEM. REPORT RESULTS TO THE LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	05/05/86 JSC-AM	
60041 R1		CREW ESCAPE CAPABI LITY FROM LIFTOFF THRU LNDNG ROLLOUT	JSC-EA 1-1 A	PROCEED WITH COMPREHEN-SIVE ENGINEERING STUDY OF ALL OPTIONS/TECHNOLO-GIES TO DETERMINE MOST OPTIMUM CREW ESCAPE SYS-TEM.	05/12/86 JSC-AM	
60042		RANGE SAFETY SYSTE M CONCERNS	JSC-AM 1-1 A	PROVIDE SPECFIC RECOMM-ENDATIONS TO THE NSTS PROGRAM MANAGER AND THE RANGE SAFETY PANEL CON-CERNING FUTURE UTILIZA-TION OF THE RANGE SAFETY DESTRUCT SYSTEMS ON SHUTTLE ELEMENTS.	05/05/86	

REPORT NO. 2102-8

S D R I S T A T U S
UNCATEGORIZED CLOSED ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60043		EMERGENCY EGRESS SLIDE	JSC-CA 1-1 A	DEFINE TIME CONSTRAINTS AND DEVELOP SPECIFIC FUNCTIONAL REQUIREMENTS, ENSURING NON-INTERFERENCE WITH NORMAL ORBITER FUNCTIONS OR CONSTRAINTS IMPOSED BY CENTAUR MISSIONS. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	04/24/86 JSC-AM	
			JSC-DA 1-2 A		04/24/86 JSC-AM	
			JSC-SA 1-3 A		04/24/86 JSC-AM	
			JSC-VA 2-1 A	DEVELOP AN IMPLEMENTATION PLAN INCLUDING COST/SCHEDULE IMPACTS. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	05/08/86 JSC-AM	

REPORT NO. 2102-8

S D R I S T A T U S
UNCATEGORIZED CLOSED ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60045		SPACELAB INSTRUMENT POINTING SYSTEM LATCH	JSC-TA 1-1 A	REVIEW RECOMMENDATION TO USE ORBITER PAYLOAD LATCHES IN LIEU OF PAYLOAD CLAMP UNITS FOR ALL IPS P/L CONFIGURATIONS AND PROPOSE IMPLEMENTATION PLAN. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	05/08/86 JSC-AM	
			MSFC-NA01 1-2 A		05/08/86 JSC-AM	
			JSC-TA 2-1 A	REVIEW PROCUREMENT OPTIONS AND MAKE SPECIFIC RECOMMENDATION. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	05/08/86 JSC-AM	

REPORT NO. 2102-8

S D R I S T A T U S
UNCATEGORIZED CLOSED ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60046		PITCH RHC SUMMING AND BENDING FILTER PLACEMENT	JSCGA/OASCB 1-1 A	DEVELOP MANPOWER/SCHEDULE/COST AND OTHER IMPACTS ASSOCIATED WITH THIS CHANGE IN CONJUNCTION WITH AN OVERALL AVIONICS SOFTWARE REVIEW. RECOMMENDATIONS REGARDING THIS CHANGE WILL BE DEVELOPED BY THE OASCB. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	05/08/86 JSC-AM	
			JSC-VA 1-2 A		05/08/86 JSC-AM	

REPORT NO. 2102-8

S D R I   S T A T U S
UNCATEGORIZED CLOSED ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60047		INADVERTENT MODE TRANSITION	JSCGA/OASCB 1-1 A	DEVELOP MANPOWER/SCHEDULE/COST AND OTHER IMPACTS ASSOCIATED WITH THIS CHANGE IN CONJUNCTION WITH AN OVERALL AVIONICS SOFTWARE REVIEW. RECOMMENDATIONS REGARDING THIS CHANGE WILL BE DEVELOPED BY THE OASCB. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	05/08/86 JSC-AM	
			JSC-VA 1-2 A		05/08/86 JSC-AM	
60048		SPLIT-S RTLS CAPABILITY FOR EARLY LOSS, 2 OR 3 SSME'S	JSC-TA 1-1 A	ANALYZE AND DEFINE ET/SRB/ORB STRUCTURAL CAPABILITY TO WITH/STAND LOADS GENERATED BY A SPLIT-S RTLS ABORT WITH 2 OR 3 ENGINES FAILED AND SRB'S THRUSTING. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	05/08/86	

REPORT NO. 2102-8

S D R·I S T A T U S
UNCATEGORIZED CLOSED ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60048			JSC-EA 1-2 A		05/08/86	
			JSC-VA 2-1 A	ASSESS IMPACTS OF EX-PANDING AND UPGRADING THE AERO DATA BASE IN THE HIGH ALPHA/LOW MACH REGIONS TO SUPPORT EFFORTS DEFINING THE IN-TEGRATED ELEMENTS STRUC-TURAL CAPABILITY. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	05/08/86	
			JSCGA/OASCB 4-1 A	DEVELOP MANPOWER/SCHE-DULE/COST AND OTHER IMPACTS ASSOCIATED WITH THIS CHANGE IN CONJUNC-TION WITH AN OVERALL AVIONICS SOFTWARE REVIEW RECOMMENDATIONS REGARD-ING THIS CHANGE WILL BE DEVELOPED BY THE OASCB. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	05/08/86	

REPORT NO. 2102-8

S D R I   S T A T U S
UNCATEGORIZED CLOSED ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60048			JSC-VA 4-2 A		05/08/86	
60049		RMS HAND CONTROLLER BIAS	KSC-SE 1-1 A	ASSESS THE IMPACTS AND PROVIDE RECOMMENDATIONS TO RESOLVE THIS ISSUE. ENSURE THAT RECOMMENDATIONS ARE INCLUDED IN THE OVERALL KSC-FMEA/CIL REVIEW. REPORT INTERIM STATUS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	05/08/86	
			JSC-VA 1-2 A		05/08/86	

REPORT NO. 2102-8

S D R I S T A T U S
UNCATEGORIZED CLOSED ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60050		RMS HAND CONTROLLER BIAS	KSC-SE 1-1 A	ASSESS THE IMPACTS AND PROVIDE RECOMMENDATIONS TO RESOLVE THIS ISSUE. ENSURE THAT RECOMMENDATIONS ARE INCLUDED IN THE OVERALL KSC FMEA/CIL REVIEW. REPORT INTERIM STATUS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	05/09/86 JSC-DA	
			JSC-VA 1-2 A		05/09/86 JSC-DA	
60051		RMS SINGLE/DIRECT DRIVE +/- SWITCH CONTACT SHORT	KSC-SE 1-1 A	ASSESS IMPACTS AND PROVIDE RECOMMENDATIONS TO RESOLVE THIS ISSUE. ENSURE THAT RECOMMENDATIONS ARE INCLUDED IN THE OVERALL KSC FMEA/CIL REVIEW. REPORT INTERIM STATUS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	05/08/86 JSC-DA	
			JSC-VA 1-2 A		05/08/86 JSC-DA	

REPORT NO. 2102-8

S D R I S T A T U S
UNCATEGORIZED CLOSED ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60053		H2 LEAKAGE FROM ET /ORB UMB DURNG GRN D LOAD/COND OR FLT	KSC-SE 3-1 A	ASSESS COST/SCHEDULE IMPACTS OF IMPLEMENTING A HAZARDOUS GAS DETECTION SYSTEM, INCLUDING REQUIREMENTS FOR SENSING AND TRANSMITTING INDICATIONS TO THE OVERALL MONITORING SYSTEM. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	05/19/86 JSC-EA	
60053 R1		H2 LEAKAGE FROM ET /ORB UMB DRNG GRND LOAD/COND OR FLT	KSC-SE 1-1 A	ASSESS COST/SCHEDULE IMPACTS OF IMPLEMENTING A HAZARDOUS GAS DETECTION SYSTEM AT KSC AND VLS INCLUDING REQUIREMENTS FOR SENSING AND TRANSMITTING INDICATIONS TO THE OVERALL MONITORING SYSTEM. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	05/19/86 JSC-AE	

REPORT NO. 2102-8

S D R I S T A T U S
UNCATEGORIZED CLOSED ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60053 R1			USAF-VLS 1-2 A		05/19/86 JSC-AE	
60063		APU CONTROLLER "BITE" ERRORS	JSC-VA 1-1 A	DEVELOP PLAN, INCLUDING IMPACTS, AND ISSUE APPROPRIATE DIRECTION TO YOUR CONTRACTOR TO PROCEED WITH IMPLEMENTATION OF THE APU CONTROLLER MODIFICATIONS. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	05/22/86 JSC-AE	

REPORT NO. 2102-8

S D R I S T A T U S
UNCATEGORIZED CLOSED ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60069		COMBUSTION INSTABILITY OF RCS PRIMARY THRUSTERS	JSC-VA 1-1 A	DEVELOP A PLAN TO RESOLVE RCS THRUSTER INSTALLATION CONCERNS, TO INCLUDE RECOMMENDATIONS ON ADDITIONAL TESTING AND THE FEASIBILITY OF IMPLEMENTING AN INSTABILITY DETECTION OR BURNTHROUGH DETECTION SYSTEM. AN INCREMENTAL APPROACH TO TESTING AND/RO ADDING INSTABILITY DETECTION CAPABILITY SHALL BE CONSIDERED,GIVING HIGHEST PRIORITY TO HIGH-USE ENGINES. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SDRB).	05/22/86 JSC-AE	
60072		INTERNAL REACTANT LEAKAGE WITHIN FUEL CELLS	JSC-VA 2-1 A	SUBMIT RCN TO UPDATE OMRSD, AS APPROPRIATE TO PERFORM N2 DIAGNOSTIC TEST EVERY FLIGHT.	05/22/86 JSC-AE	

REPORT NO. 2102-8

S D R I S T A T U S
UNCATEGORIZED CLOSED ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60072			JSC-EA 3-1 A	DEVELOP PLAN AND ASSESS IMPACTS FOR REDESIGN OF CELL PERFORMANCE MONITOR. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	05/22/86 JSC-AE	
60074 R1		WCS WIRE HARNESS F LAMMABILITY	JSC-GM13 3-1 A	UPDATE THE BARS MKK FILE TO REFLECT INSTALLATION OF A MODIFIED WCS WIRE HARNESS CONTAINING NO RAYCHEM WIRING.	07/11/86 JSC-AE	
60075		ARS - EXTERNAL LEA KAGE OF EMERGENCY O2 SYSTEM	JSC-GA/M 1-1 A	INCLUDE SDRI #JEC006 IN CIL/FMEA REVIEW.	05/01/86 JSC-EA	
60088		MLG DOOR BOOSTER B UNGEE	JSC-VA 1-1 A	RE-INITIATE TASK TO DETERMINE POSITIVE METHOD OF RIGGING BUNGEE TO ENSURE THAT IT IS PROPERLY SET. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	06/02/86 JSC-AE	

REPORT NO. 2102-8

S D R I S T A T U S
UNCATEGORIZED CLOSED ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60088			JSC-VA 2-1 A	REVIEW CURRENT DESIGN FOR POTENTIAL IMPROVEMENT INCLUDING DIFFERENT MEHTODS OF APPLYING DOOR OPENING FORCE AND REDUCTION IN BUNGEE TENSION. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	06/02/86 JSC-AE	
60089		IMPROVED TPS AROUND NOSE CAP	JSC-VA 1-1 A	ASSESS TWO PROPOSED REDESIGNS OF TPS IN ORB NOSE AREA AND DEVELOP IMPACTS OR IMPLEMENTATION OF EACH. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	06/02/86 JSC-AE	
60090		WING/ELEV COVE AREA REDESIGN TO PRECLUDE PLASMA FLOW	JSC-VA 1-1 A	PROVIDE RECOMMENDATIONS FOR REDESIGN OF THE WING/ELEVON COVE AREA (CURRENTLY BEING WORKED) REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	06/02/86 JSC-AE	

REPORT NO. 2102-8

S D R I S T A T U S
UNCATEGORIZED CLOSED ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60091		POSSIBLE CROSS-CONNECTING OF GROUND RACK PIC CONNECTOR	KSC-SE 1-1 A	DEVELOP PLAN TO PRECLUDE CROSS-CONNECTING THE GROUND PIC RACK OUTPUTS. INCLUDE ALL PROCEDURAL AND HARDWARE (KEYED CONNECTORS) APPROACHES AND RELATED COST/ SCHEDULE IMPACTS. REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	06/02/86 JSC-AE	
			JSC-GA/M 2-1 A	REVIEW AND IDENTIFY ALL NON-KEYED GSE CONNECTORS LISTED IN CONTROLLED HAZARDS DOCUMENT, AND ASSESS SAFETY, RATIONALE FOR ACCEPTANCE AND THE DEGREE OF HAZARD INVOLVED.	06/02/86 JSC-AE	

REPORT NO. 2102-8

S D R I S T A T U S
UNCATEGORIZED CLOSED ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60117		TPS BOND INTEGRITY OV OV-102	JSC-VA 1-1 A	INCLUDE IN YOUR PLANNING CONSISTENT WITH OTHER PROGRAM PRIORITIES, THE REPLACEMENT OF THE SUS- PECT OV-102 TILES (THOSE BONDED TO ADJACENT TILES) WITH OV-103 DE- SIGN TILES. REPORT SCHEDULING CONSIDERATION TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	07/11/86 JSC-AE	
60135		GSE INTERFACE FILT ERS IN ORBITER FLU ID LINES	JSC-TE 2-1 A	INCORPORATE THIS ISSUE, REGARDING PROVISION OF GSE INTERFACE FILTERS IN THE ORBITER FLUID SYSTEMS, INTO THE DESIGN CERTIFICATION REVIEW ACTIVITIES.	07/11/86 JSC-NA	

REPORT NO. 2102-8

S D R I S T A T U S
UNCATEGORIZED CLOSED ACTIONS

PCIN NUMBER	CAT ISS ACT	SDRI DESCRIPTION	ACTION IDENT	ACTION REQUIRED	DUE DATE SPONSOR ORG	IMPACTS COST WEIGHT SCHEDULE
60144		MPS - SSME CRITICA LITY VALVES	MSFC-SSME 1-1 A	PROVIDE BASIS OF PRESENT SSME CHECK VALVE CONFIG-URATION AND ASSESS IMPACTS OF MAKING THESE CHECK VALVES REDUNDANT. INCLUDE CHARACTERISTICS OF A REDESIGN, ENGINE PERFORMANCE, ACCESSIBI-LITY, AND PRESSURE DROP CONSIDERATIONS FROM ADDITION OF CHECK VALVES REPORT RESULTS TO THE SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	06/16/86 JSC-NA	
60146		LOSS OF ORB WINDSH LD DUE TO THERMAL STRESS/BIRD IMPACT	JSC-VA 1-1 A	ASSESS IMPACTS FOR CON-DUCTING MEANINGFUL TESTS TO DETERMINE THE CAPABI-LITY OF CURRENT ORBITER WINDOWS TO WITHSTAND BIRD IMPACTS. REPORT RESULTS TO SPECIAL LEVEL II PRCB (SYSTEM DESIGN REVIEW BOARD).	06/16/86 JSC-NA	